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AVIATION DEAFNESS—ACUTE AND CHRONIC

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Since the Wright brothers made their inaugural flight at Kitty Hawk, N. C., on Dec. 17, 1903, sporadic observations concerning the effects of flight on the ears have appeared in the literature of most of the aviation-minded nations. The more serious and scientific reports began about 1926, with the observations of Bauer in his treatise "Aviation Medicine." [1] This has been followed by excellent investigations and observations by Myrick,[2] Bunch,[3] Armstrong and Heim [4] and most recently by the work of Dickson, Ewing and Littler of England.[5]

After a survey of the literature, our experience and investigative work at the School of Aviation Medicine at Randolph Field, Texas, led us to believe that a further clarification of the matter would be timely.

It is our belief that the deafness of aviators may be classified according to cause as follows:

1. Acute fatigue of the end organ of hearing and related structures.
2. Chronic accumulative fatigue of the end organ and related structures.

From the Department of Otolaryngology of the United States Army Air Corps, School of Aviation Medicine.

1. Bauer, L. H.: Aviation Medicine, Baltimore, Williams & Wilkins Company, 1926, p. 157.

2. Myrick, C. B.: Effect of Flight upon Hearing, Proc. Inst. Radio Engineers **17**:2283-2296, 1929.

3. Bunch, C. C.: Symposium: Neural Mechanism of Hearing; Nerve Deafness of Known Pathology or Etiology, Laryngoscope **47**:615-691, 1937.

4. (*a*) Armstrong, H. G., and Heim, J. W.: The Effect of Flight on the Middle Ear, J. A. M. A. **109**:417-421 (Aug. 7) 1937. (*b*) Armstrong, H. G.: Principles and Practice of Aviation Medicine, Baltimore, Williams & Wilkins Company, 1939, pp. 193-217.

5. Dickson, E. D. D.; Ewing, A. W. G., and Littler, T. S.: The Effects of Aeroplane Noise on the Auditory Acuity of Aviators: Some Preliminary Remarks, J. Laryng. & Otol. **54**:531-548, 1939.

3. Conduction deafness due to changes in pressure in the middle ear.
4. Chronic conduction deafness due to alteration in tissue resulting from faulty ventilation of the middle ear.

We feel that if the eustachian tubes allow the middle ear to be ventilated properly the only condition with which one must deal is fatigue of the end organ of hearing until fatigue, through the severity of its application or the length of time it is applied, becomes chronic in the form of accumulative fatigue and in its severest form fits into the usual conception of traumatic perception deafness. If, on the other hand, the middle ear, through pathologic closure of the eustachian tube or through physiologic failure of the eustachian tube to open, as in sleep, fails to be ventilated completely and periodically during the positive and negative changes in pressure produced by variation in altitude, the picture of conduction deafness may be superimposed in amounts depending on the severity and duration of the application of pressure. This we believe explains the variations in the audiograms attributed to the effects of flight by various investigators.

FATIGUE

It has long been known that all living tissue is susceptible to the phenomenon of fatigue. Howell [6] said, "We may define fatigue . . . as a more or less complete loss of irritability brought about by functional activity." To fit the general physiologic conception of fatigue, the resultant effect of a fatiguing process should be in proportion to the strength and length of time of the application of the process, and the time of recovery after the fatiguing force is removed should be in proportion to the strength and duration of the application of the force. Certain other factors, such as oxygenation, the speed of removal of waste products of the metabolism of the fatigued tissues and the speed by which destroyed tissue can be replaced, also enter the reaction in varying degrees, depending on the type of tissue involved. End organs are particularly susceptible to fatigue, the end organs of hearing notably so, in spite of poor confirmation obtained from laboratory experiments on animals.[7] For many years otologists have known that simple stimuli, such as a tuning fork held near the ear, will cause fatigue and that in the testing of hearing by forks the instrument must be periodically removed and reapplied or the minimal sound intensity heard will be above the actual threshold for that tone. Thus small forces are known to produce certain degrees of fatigue of the end organ of hearing.

With this in mind one of us (P. A. C.) flew a total of fifty hours in units of one, two and four hours under varying circumstances, at varying altitudes, in various types of aircraft, over a period of six weeks.

6. Howell, W. H.: A Textbook of Physiology, ed. 10, Philadelphia, W. B. Saunders Company, 1927, pp. 70-71.

7. Stevens, S. S., and Davis, H.: Hearing: Its Psychology and Physiology, New York, John Wiley & Sons, Inc., 1938, pp. 217-225.

As the amount of flying he had done before the experiment was negligible and as he had done no flying for four years, he was considered a fit subject. His middle and external ears were known to be normal. His eustachian tubes were able to ventilate the middle ears on each act of swallowing or if the middle ear pressure was elevated even slightly, as in small increases of altitude (200 to 400 feet [60 to 120 meters]). His audiogram had been taken monthly over a period of six months and was known not to vary in amounts greater than technical limits of error (2 to 3 decibels). Two hours before the first flight his audiogram was taken and was demonstrated to be the same as during previous monthly checks. For the purpose of analysis and presentation

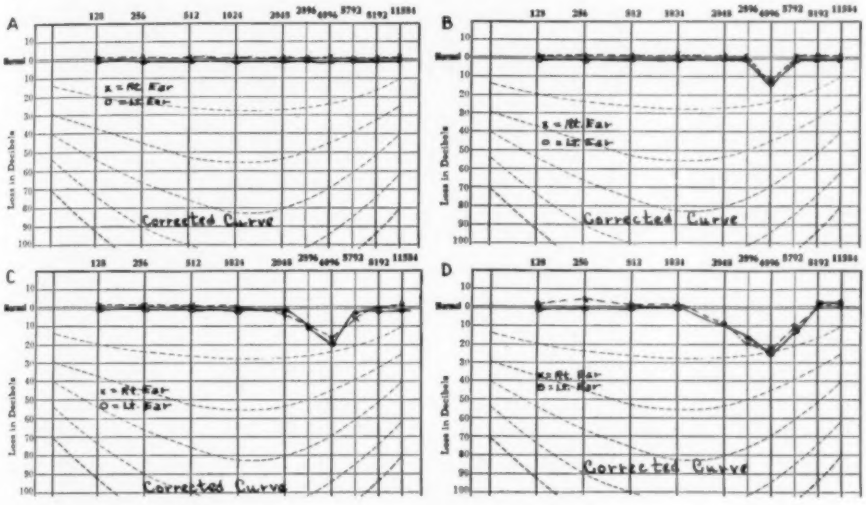

Chart 1.—Audiograms. *A*, average curve two hours before first flight. *B*, average curve after six one hour periods of flight on different days. Average time required for complete recovery after flights, one hour and thirty-four minutes. *C*, average curve after six two hour periods of flight on different days. The time required for complete recovery of hearing after these flights averaged four hours and fifteen minutes. *D*, average curve after four periods of flight of four hours each on different days. Recovery of hearing was complete after an average of sixteen hours.

its minor dips and rises were ironed out, giving a straight line corrected curve. These minor plus and minus corrections were applied in each subsequent audiogram, so that only the curve produced by flight was present. Immediately after return to earth (five to ten minutes) after each unit of time, an audiogram was made. The results noted in the curve of hearing are shown in chart 1*A*.

From the chart it is rather obvious that a notch in the curve of hearing occurs with its peak at the 4096 level; that complete recovery, in this particular experiment, has followed in a period of

time which approaches the square of the time the fatiguing force was applied. This, we believe, fits into the general physiologic conception of fatigue.

Force of the Fatiguing Elements.—For this experiment two periods of two hours each were spent in flight in a single-motored aircraft (Army BT9) (table); then the subject flew two similar periods in a twin-motored aircraft (Army B-10) (table), in which the motors were both larger than that of the single-motored craft. Other conditions were similar.

These two curves (chart 2) demonstrate a relationship between the force of the fatiguing element and the amount of fatigue produced, although the difference is slight. This small difference is accounted for by H. G. Armstrong in his excellent text [4b] in the statement, ". . . if

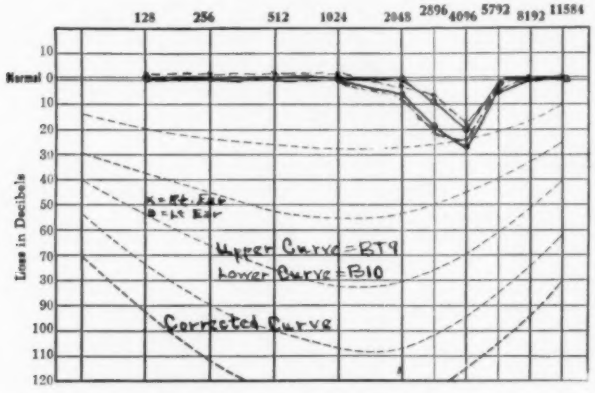

Chart 2.—Audiogram showing average corrected curve of hearing following flights in twin-motored and single-motored aircraft. The upper curve was obtained after a flight in single-motored aircraft BT-9; the lower curve, after flight in twin-motored aircraft B-10.

several noises arrive at the same point with equal intensity, the combined noise level will be only a few decibels above that of any one component."

At this point it is of interest to compare the average loss of hearing produced by various forms of army aircraft during this experiment. The aircraft flown and their number of cylinders, horsepower, revolutions per minute and type are shown in the accompanying table:

Data on Aircraft

Aircraft	No. of Cylinders of Engine	Horsepower	Revolutions per Minute	Type
BT-2	9	350	1,850	Open cockpit biplane
BT-9	9	400	1,850	Low wing monoplane, canopied cockpit
B-10	2-9 cyl. engines	425 each	1,800	Low wing monoplane, canopied cockpit
B-18	2-9 cyl. engines	450 each	1,900	Low wing monoplane, enclosed cockpit
A-17	14 cyl.	525	1,800	Low wing monoplane, canopied cockpit

The average fatigue loss in hearing produced by a flight of one hour's duration is shown in chart 3*A*. The relatively high loss produced by flight in low powered BT-2 is undoubtedly due to its open cockpit.

Characteristics of the Fatiguing Force.—The noise produced by aircraft is made up of many sounds of different frequency and intensity. There are also vibratory forces present in the infra-audible range and certainly many in the suprasonic range. The sounds are (1) engine explosions, (2) propeller hum, (3) sounds produced by wing and slip

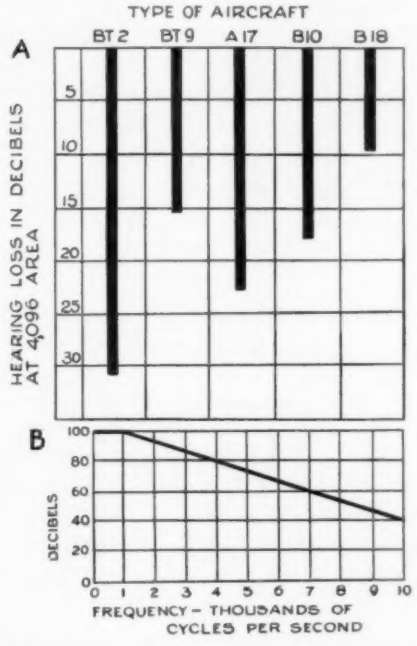

Chart 3.—*A*, acute loss of hearing produced by fatigue from flight in various forms of military aircraft. BT-2 is the only open cockpit plane of the group. *B*, distribution of sound intensities in a nonsoundproofed bimotored airplane in flight (from Armstrong [4b]).

stream effect on structures and (4) sounds from moving parts. Vibratory energies which might also fatigue the end organs of hearing are (1) preaudible positive and negative changes in pressure from the motion of the propeller and (2) suprasonic vibratory frequencies from objects moving at high speeds, with their overtones. The intensities of these sounds have been measured and recorded by several observers as lying between 80 decibels in the sound-proofed cabins and 120 to 130 decibels in open cockpit aircraft, with the ear of the subject in the slip stream. H. G. Armstrong recorded the distribution of sound frequencies and

intensities of the audible range in a graph (chart 3 *B*) which he has given us permission to use.[4b]

From this graph it is evident that the major part of the fatiguing force lies under 1000 double vibrations per second. It has been our experience, as well as the experience of others, that this force reaches its greatest intensity between 200 and 500 double vibrations per second. Why, then, does a sound of frequency below 4096 double vibrations per second produce fatigue in the 4096 area of the cochlea? This phenomenon has been known for many years in connection with occupational deafness. Crowe, Guild and Polvogt,[8] in their histologic studies of a group of ears with abrupt loss of acuity for high tones, found atrophy of the organ of Corti at some level above the last 2 mm. of the basal turn of the cochlea. The cochlear representation of the 4096 area is believed to lie in the basal turn of the cochlea not far from the oval and round windows, in a position exposed to vibratory energy traversing the middle ear, whether it be through the ossicles, the surrounding bony structures or directly through the round window. This, we feel, may account for the peculiar vulnerability of this frequency area to the noises produced by flight. It has been suggested by some observers that this particular area is deficient in blood supply. If this is true, then the decreased metabolism of the area, especially in the presence of a poor supply of oxygen,[9] would render it more fatigable.

CHRONIC ACCUMULATIVE FATIGUE

As has been previously stated, it is our experience that the recovery of hearing after small degrees of fatigue, as in the preceding experiments, is complete after a period of rest. However, constant repetition of the insult has an accumulative effect which results in permanent loss. The amount of fatigue necessary to produce permanent loss varies greatly with the person. This of course is true of all forms of fatigue. Every one knows people who seem to go on forever without permanent effects from fatigue, and also people who fatigue without adequate reason. This is a matter of everyday experience and is probably based on heredity, anatomic relationships, growth, endocrine balance, circulation, age, nervous stability and many other factors. We believe it

8. Crowe, S. J.; Guild, S. R., and Polvogt, L. M.: Pathology of High Tone Deafness, Bull. Johns Hopkins Hosp. **54**:315-379, 1934.

9. While the percentage of oxygen in atmospheric air remains constant up to 72,000 feet, the decrease in barometric pressure with altitude causes a decrease in partial pressure at which the oxygen is delivered to the body. Thus with each thousand feet of ascent the oxygenation of tissues is considerably decreased, reaching critical levels at a height over 14,000 feet unless it can be supplied through artificial sources.

accounts for many of the great discrepancies in the amount of permanent loss of hearing shown by flyers.

In our experience the first permanent notch in the 4096 area of an aviator's audiometric record often appears after a period in the neighborhood of two hundred and fifty hours of flying in an open cockpit. A typical picture is presented in the audiogram (chart 4 *A*) made after the subject had spent two hundred and seventy-five hours in the air.

However, after severe insults a great permanent loss may appear in a short time. The audiogram of Capt. C. R. S. (chart 4 *B*) is particularly interesting from this point of view. He did not notice any particular defect in his hearing until after three hundred hours' exposure in

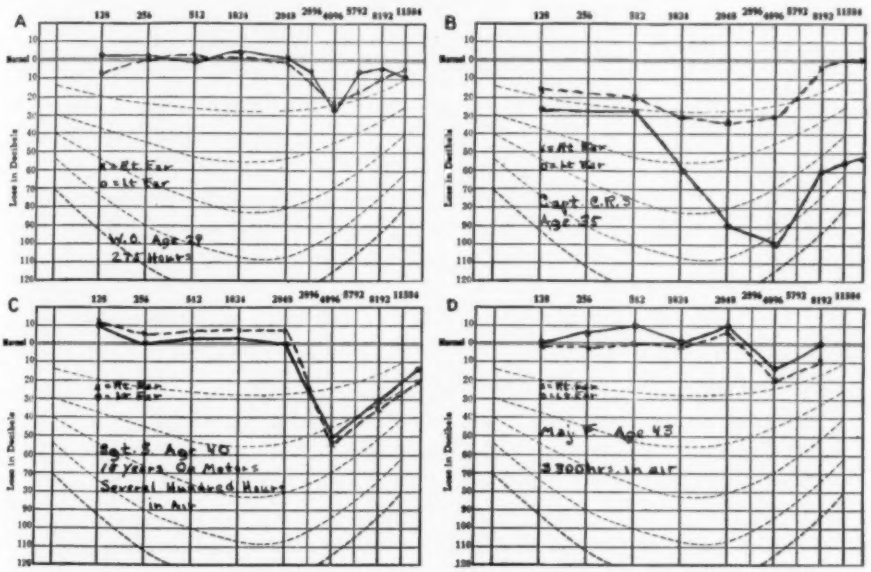

Chart 4.—*A*, audiogram made after the subject (W. O., aged 29) had spent two hundred and seventy-five hours in the air. *B*, resting audiogram of Capt. C. R. S., aged 35. *C*, resting audiogram of Technical Sgt. S., aged 40. *D*, resting audiogram of Major F., aged 43.

an S.U. type of airplane with a short exhaust stack on the left side. The audiogram of Technical Sgt. S. (chart 4 *C*), aged 40, who had worked on aviation motors for the past fifteen years and had been in the air several hundred hours, shows a result typical of rather severe prolonged insult. The factor of individual susceptibility is demonstrated by Major F., aged 43, who had thirty-three hundred hours of flying to his credit and very little defect in hearing (chart 4 *D*).

Thus we believe that after a sufficient time of exposure, depending on the force of the exposure and individual susceptibility, the loss of

hearing produced by simple fatigue becomes permanent and that additional exposure deepens and spreads fanwise, the 4096 notch encroaching on areas which cause clinical conversational deafness. This is a pure perception high tone deafness, with the reaction to the Rinne test positive and without any aspects of conduction deafness. Whether or not there are traumatic changes in the cochlea or in the eighth nerve and its connections must await the pathologist's investigations of the temporal bone. It is a picture similar to that of traumatic perception deafness described by Bunch.[3]

DEAFNESS CAUSED BY CHANGES OF PRESSURE IN THE MIDDLE EAR

Alteration of equilibrium of pressure between the outside and the middle ear has been known for many decades to cause changes in the acuity of hearing in the lower tone level. This equilibrium is maintained by the simple process of ventilation through the eustachian tube. When the apparatus is normal, ventilation is carried out by the voluntary or involuntary act of swallowing, if the pressure, as in descent, is greater outside the middle ear than inside. If the pressure is greater inside the middle ear than outside, as in ascent, then ventilation can be caused directly by the higher pressure air forcing itself out through the eustachian tube or by the act of swallowing. Armstrong [4b] pointed out that in ascent an increase in pressure of about 15 mm. of mercury will force the eustachian tube open, with consequent ventilation, while in descent, because of the flutter valve action of the eustachian orifice only the act of swallowing will ventilate the middle ear. A differential pressure of 90 mm. of mercury in descent will lock the orifice, because of its flutter valve action, in such a manner that the act of swallowing will no longer open it and the acutely painful condition which he calls acute aero-otitis media results. Descents of 300 feet (90 meters) per minute are within the range of comfort if normal swallowing is taking place. This is the maximum speed of descent allowed by air lines in routine flight.[10] Descents in the range of 1,000 feet (300 meters) per minute are unbearable, and locking of the eustachian tube often results. The average person while awake swallows every minute or so, but while asleep, only about once in five minutes; consequently the sleeping person, even in very slow descents, is in danger of acute closure with severe middle ear pressure differentials.

In order to get some first hand information on the alterations in hearing produced by acute changes in pressure in the middle ear, one of us (P. A. C.) ascended to 12,000 feet (3,600 meters) and then

10. Tuttle, A. D.: Safety and Comfort Aloft, J. Aviation Med. **10**:72-86, 1939.

descended to the ground at a rate of 2,000 feet (600 meters) per minute and purposely attempted not to swallow. He noted the following results: In the slow ascent the eustachian tubes were opening normally, and there was no pain or noticeable decrease in acuity of hearing. In the rapid descent it was very difficult for him not to swallow, but after a descent of 5,000 feet (1,500 meters) he was forced by pain to swallow. This act ventilated the left middle ear, but, regardless of further attempts at swallowing, the right middle ear was not ventilated,

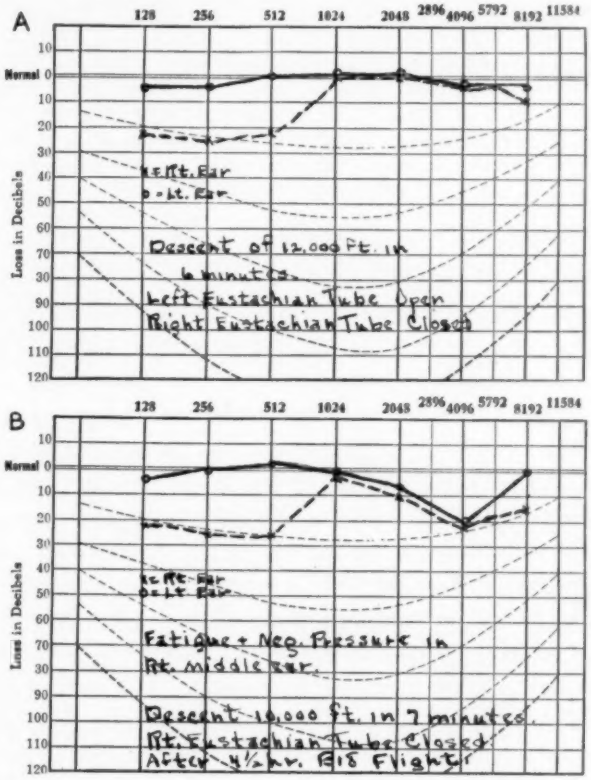

Chart 5.—Audiograms. *A*, hearing curve resulting from acute negative pressure in the middle ear (acute aero-otitis media of Armstrong and Heim) produced by a descent of 12,000 feet in six minutes. *B*, loss of hearing due to acute fatigue coincident with acute negative pressure changes in the right middle ear.

and the condition described as acute aero-otitis, with its severe pain radiating to the temporomandibular joint and parotid gland, supervened. The resulting curve of hearing loss is shown in chart 5 *A*. The reaction to the Rinne test was negative. In the Weber test the sound was lateralized to the affected side. The hearing curve had returned

to normal and all symptoms had subsided in seventy-two hours, without treatment.

On another occasion the same observer, after a four and one-half hour flight in a B-18 (two-motored aircraft) descended 10,000 feet (3,000 meters) in seven minutes, purposely not swallowing until forced to, with the same failure to ventilate the left middle ear and with the same approximate results in a lesser degree, but with the acute fatigue factor of four and one-half hours superimposed. The resulting curve of loss in hearing is shown in chart 5 *B*.

Thus we believe that the changes in hearing produced by acute changes of pressure in the middle ear are of the pure conduction type, involving only the lower tone range. When these pressure changes are coincident with fatigue the curve of mixed conduction and perception deafness results.

CHRONIC CONDUCTION DEAFNESS DUE TO ALTERATION OF TISSUE RESULTING FROM FAULTY VENTILATION OF THE MIDDLE EAR

After repeated insults to the structures in and surrounding the middle ear—the drum, the ossicles, the mucous membrane lining of the middle ear and eustachian tube—chronic changes may take place. These are characterized by retraction, with its cardinal features—prominence of the short process, rotation of the handle of the malleus and dulness of the drum, with thickening and alterations in the cone of light. Accumulations of fluid may occur in the middle ear from time to time. In its most severe manifestations perforation of the drum, with complicating chronic purulent otitis media and its usual pathologic changes, may be present. The lining mucous membrane of the eustachian tube may be so thick that ventilation by any of the usual methods, such as politzerization or catheterization, becomes impossible. The patient is clinically deaf, especially for lower tones. To the otologist this picture is a more or less common occurrence and needs no further description, as it is chronic catarrhal otitis media, pure or with its complications. The audiogram, as would be expected, shows loss of acuity for low tones. The reaction to the Rinne test is negative.

This picture is present only in those persons in whom the middle ear is not ventilated properly. There are numerous causes for the failure of this valvelike action. Among the more common is inflammation in the region of the eustachian orifice from any cause; cold, sinusitis and infected tonsils, adenoids or lymphoid tissue are the most common. Hypertrophy, anatomic deformity or tumor growth of surrounding structures may be a potent cause. Lately much attention has

been paid to a disturbance in function of the temporomandibular joint and its effect on the proper functioning of the eustachian orifice.[11]

MIXED DEAFNESS

It is obvious that any or all of the four classifications of deafness described in the foregoing paragraphs may occur simultaneously in the aviator, in any proportion. One must also consider that persons are now flying who represent all age groups. The flyers, like all other human beings, have been exposed to the usual aural diseases and changes coincident with life. Thus one must not forget that their hearing may be affected by other factors than that of their vocation or avocation, and that their audiograms may show any possible curve.

The advance in aircraft design and in flight regulation has been rapid. Sound-proof cabins are replacing inadequately protected cockpits. Air lines have adopted regulations against rapid altitudinal changes. By education those who fly are taught the necessity of ventilation of the middle ear. Babies are given fluids by the stewardess, to sip in ascent and descent. The constant pressure cabin type of aircraft will soon be in everyday use. Thus losses of hearing in those who fly may not be a serious problem of the future.

CONCLUSIONS

The deafness of aviators may be classified according to cause:

1. Acute fatigue of the end organs of hearing and related structures.
2. Chronic accumulative fatigue of the end organ and related structures.
3. Changes in middle ear pressure inherent with changes in altitude if ventilation of the middle ear is faulty.
4. Chronic conduction deafness due to alteration in tissue resulting from faulty ventilation of the middle ear.

The first two classifications are manifest by a decrease in acuity of hearing in the neighborhood of the 4096 area—a perception deafness.

The last two classifications are manifest by a decrease in acuity for the lower frequencies (128 to 1024), a form of conduction deafness.

The conduction deafness and the perception deafness may be mixed to give any form of audiogram. The audiogram may be altered by the usual changes and hazards coincident with life.

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11. Crawford, W. M.: Malocclusion and Its Relation to Temporo-Mandibular Disorders, Laryngoscope **47**:532-537, 1937. Costen, J. B.: A Syndrome of Ear and Sinus Symptoms Dependent on Disturbed Function of the Temporo-Mandibular Joint, Ann. Otol., Rhin. & Laryng. **43**:1-15, 1934. Willhelmy, G. E.: Ear Symptoms Incidental to Sudden Altitude Changes and the Factor of Overclosure of the Mandible: Preliminary Report, U. S. Nav. M. Bull. **34**:533-541, 1936.

Fatigue of the end organ of hearing is due to noise and the effect of other vibratory energies inherent with flight. The 4096 area is peculiarly vulnerable because of its exposed position and possibly altered blood supply.

Altitudinal decrease in oxygen may be a factor in the production of fatigue.

Physiologic or pathologic failure of the middle ear to be ventilated properly during altitudinal changes in pressure leads to acute or chronic changes in the middle ear, with the usual picture of conduction deafness.

Rapid advance in aircraft design and in flight regulation will decrease the problem of loss of hearing in those who fly in the future.

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CERTAIN REACTIONS OF LARYNGEAL TISSUES TO MEDICINAL AGENTS

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Reactions of laryngeal tissues to various medicaments have apparently, so far as various authoritative writers are concerned, been assumed from observation of clinical effects and from the gross behavior and histologic appearance of more accessible tissues in the nose, mouth and pharynx. It is of course a commonplace among laryngologists that tissues above the epiglottis are definitely more resistant to local trauma than are the mucosal and submucosal structures of the larynx itself.

It was thought desirable, therefore, to expose the glottis in young cats anesthetized by pentobarbital sodium administered intraperitoneally; a small Jackson laryngoscope was used, and the posterior surface of the epiglottis and upper aspect of the larynx were gently swabbed with various therapeutic solutions not uncommonly used. Irritation by respiratory anesthesia was thus entirely avoided. Within twenty-four hours these animals were killed by section of the cervical portion of the cord or by an overdose of pentobarbital sodium, and the larynges were fixed in Zenker's solution, embedded in pyroxylin (celloidin) or paraffin and stained with hematoxylin and eosin.

I shall not discuss the action of the drugs or the therapeutic indications for the solutions employed. The following substances were chosen to demonstrate histologic changes in the laryngeal tissues: 50 per cent trichloroacetic acid in water; 1 per cent thymol in liquid petrolatum; 50 per cent lactic acid in water; 1 per cent monoparachlorophenol in water; 1 per cent silver nitrate in water; 1 per cent chaulmoogra oil in sesame oil; 20 per cent mild protein silver in water; 1 per cent mercurochrome in water, and 2 per cent gomenol (a cajuput oil from Melaleuca viridiflora) in oil.

RESULTS

Fifty Per Cent Trichloroacetic Acid in Water.—The first animal to which this solution was administered died within half an hour from an overdose of pentobarbital sodium. Histologic examination showed loss

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of surface cells and some cellular exudate in the lumens; the blood vessels of the submucosa were slightly injected. Tissues from a second animal, secured after twenty-four hours, showed gross edema and pallor of the larynx, with a narrow tracheal opening. The surface epithelium was largely destroyed, the destruction reaching the tunica propria in certain patches. The remaining, deeper epithelium was covered by cellular exudate, with much leukocytic infiltration of deeper layers and of the tunica propria, although in the latter the infiltration was not marked. The blood vessels were slightly injected.

One Per Cent Thymol in Liquid Petrolatum.—The animal receiving this medicament recovered poorly, and tissues were therefore secured after eighteen hours. The larynx was filled with mucus and appeared edematous; the lungs were congested. The epithelial surfaces were roughened, and the surface cells swollen; there was considerable leukocytic infiltration in the basal portion of the epithelium and about the submucosal mucous glands, which were markedly active. The lumens of these glands were swollen with secretion; many also contained leukocytes. There was a moderate degree of vascular congestion.

This medicament was used on a second animal to secure the full twenty-four hour response. In this instance the larynx and the trachea were pale and edematous, but the glottis was large, and there was no accumulation of mucus. Microscopically the mucosa was only slightly thickened but markedly infiltrated by leukocytes. The surface layers of epithelium were destroyed and desquamated, with some swelling of cells in the deeper layers. Desquamation extended in patches to the basal layer, and there was some vascular congestion.

Fifty Per Cent Lactic Acid in Water.—The animal to which this solution was given survived an overdose of the anesthetic only eighteen hours; grossly the larynx was pale, edematous and filled with mucus, only a small respiratory space being left. The lungs were normal. The epithelium was largely destroyed, down to the tunica propria, or basal layer of cells. There was marked submucosal leukocytic infiltration, especially about the mucous glands, which had been very active. Vascular injection was marked.

A second animal was used to secure tissues after twenty-four hours. Grossly the laryngeal mucosa was edematous and pale but the glottis was fairly wide. Microscopically the epithelium was destroyed over large areas down to the basal layer, with marked infiltration of the tunica propria by leukocytes and other cells. The mucous glands were active; many were infiltrated by leukocytes, and their lumens were filled by these cells. The mucosal surface was covered by an exudate of desquamated epithelial cells and leukocytes. The remaining epithelial cells were much swollen. At points directly touched by the applicator the mucosa and submucosal tissues were markedly infiltrated.

One Per Cent Monoparachlorophenol in Water.—The animal on which this medicament was used survived eighteen hours. Grossly the membranes were thick and edematous; the glottis was small, but the lungs were normal. The epithelium was destroyed in many places to the second and the third layer; elsewhere only the first layer was gone. There were marked mucous glandular activity in the larynx and the upper part of the trachea and a considerable amount of cellular exudate in the trachea, just below the larynx. Rather marked leukocytic and lymphocytic infiltration was observed around the mucous glands, and the submucosal vessels were moderately injected.

One Per Cent Silver Nitrate in Water.—Tissues secured after twenty-four hours showed the larynx full of mucus, the membrane pinkish and the lungs normal. Slight epithelial destruction was present, involving only the surface layers, the submucosal vessels were injected, and a small amount of cellular exudate was noted.

One Per Cent Chaulmoogra Oil in Sesame Oil.—Tissues secured after twenty-four hours showed the larynx pale and the glottis wide, without mucus. Microscopically the epithelium was peculiarly thickened, showing a serrated free margin. Deep in the epithelium cysts of various sizes occurred, some filled with leukocytes. The deeper epithelial layers were infiltrated with leukocytes, but vascular injection was slight.

Twenty Per Cent Mild Protein Silver in Water.—Tissues recovered after twenty-four hours showed an edematous, pale larynx, without gross exudate and with a wide open glottis. Microscopically there was little change from the normal in the stratified squamous epithelium of the larynx proper, but patchy destruction of the ciliated columar epithelium of the upper portion of the trachea was observed. Some leukocytic infiltration of the laryngeal epithelium had occurred. The mucous glands were strongly infiltrated, with numerous leukocytes in their lumens. Some vascular congestion had taken place.

One Per Cent Mercurochrome in Water.—Tissues recovered after twenty-five hours showed a pale slightly edematous larynx, with a narrow glottis but no mucus. Microscopically, some areas showed marked and others slight leukocytic infiltration, while elsewhere the epithelium was arranged in serrated folds, with small cysts containing leukocytes. In a few areas epithelium had been sloughed off down to the tunica propria; there was some blood on the epithelial surface.

Two Per Cent Gomenol in Olive Oil.—Tissues secured after twenty-six hours showed the larynx pink and edematous; the glottis contained a slight mucous discharge and was swollen partially shut. Microscopically certain patches of epithelium had been destroyed down to the tunica propria, and such areas were replaced by a thin layer of red

blood corpuscles. The remaining epithelium and its underlying tunica propria showed a considerable amount of leukocytic infiltration, with some vascular congestion.

COMMENT

One should consider, first, the effects of these drugs on the laryngeal epithelium, discounting as negligible for the purpose of this study any mechanical effect, such as pressure from the lip of the laryngoscope, and, second, reparative or irritative reactions demonstrable in the tunica propria. Of all the mucous membranes of the respiratory tract this submucosal stroma has by far the greatest reparative power. Epithelium is readily damaged, but with a healthy stroma below it is speedily repaired, although not always with the same cells as at first.

Strong caustics—lactic and trichloroacetic acids (50 per cent)—proved violently destructive to the laryngeal epithelium. Marked activity of the mucous glands, coupled with pronounced leukocytic infiltration, pointed to an immediate stimulation of reparative effort.

One per cent monoparachlorophenol, which is commonly injected intratracheally, stirred up pronounced epithelial losses and edema; but together with a good deal of exudate there occurred marked glandular activity and lymphocytic and leukocytic infiltration. This is a potent and rather caustic agent, but it apparently also promotes strong defensive reactions.

One per cent silver nitrate showed little surface damage after twenty-four hours, with relatively slight submucosal injection.

A curious puckering of the epithelium, without much tissue loss and with numerous subepithelial cysts surrounded by leukocytes, was observed both with 1 per cent mercurochrome in water and with 1 per cent chaulmoogra oil in sesame oil.

Twenty per cent mild protein silver in water caused little epithelial damage but much stimulation of mucous glands and the surrounding stroma.

Typical of the aromatic oils, 1 per cent thymol in liquid petrolatum and 2 per cent gomenol in olive oil both caused considerable edema, thymol accumulating little exudate, while gomenol was responsible for a good deal. Epithelial loss occurred with both, with well marked leukocytic infiltration and vascular congestion.

Reparative efforts are stirred up by all these substances, but serious epithelial losses occur with all the stronger solutions, whether oily or aqueous. Fortunately the cough reflex rapidly removes most intralaryngeal irritants. These experimental animals were not able to cough for several hours owing to deep anesthesia, which may explain the severity of some of the reactions.

Nevertheless, in line with previous microscopic observations on the sinal membranes, it may be asserted that local applications to the larynx should be highly dilute and small, limited strictly to the region in which stimulation or reparative or antiseptic action is desired. Inundating the larynx with instillations of powerful drugs may do far more harm than good.

The histologic effects observed seemed to be due largely to absorption of the aqueous content of epithelial cells by the hypertonic medicaments employed. Immediately after application, nature endeavors to wash away the irritant by increased secretion of mucus. Actual epithelial losses, covered at first by a thickened mucous sheet, receive reenforcements consisting of large numbers of polymorphonuclear leukocytes and lymphocytes.

It would be interesting to preserve a series of animals for longer periods after experimental laryngeal swabbing. The rapid reparative response already observed would probably in most instances lead to regrowth of normal epithelial tissues within a relatively short time.

Comparatively slight reaction from oily solutions, in spite of abolition of the cough reflex by heavy anesthesia, suggests the comment that damage from nonabsorbable oils in the tracheobronchial tree is due to the thin and delicate mucosal protection of bronchioles and alveoli. The larynx has, per contra, epithelium of several layers with a highly vascular tunica propria and is normally guarded by a cough reflex of explosive violence, so that powerful agents would not under normal circumstances remain long in contact with the glottic region.

This brief series of observations is in no sense conclusive, but it is hoped that a little light has been thrown on the question of what happens to laryngeal tissues when local medication is used.

The tissues were prepared under the supervision of Dr. Larsell, and his opinions respecting the changes have been extremely valuable.

MYASTHENIA LARYNGIS

OBSERVATIONS ON THE LARYNX AS AN AIR COLUMN INSTRUMENT

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The purpose of this paper is to present observations on the phonatory mechanism of the larynx revealing a close analogy with the phonetic mechanism of air column instruments of the cornet type. These observations evidently have an important bearing on those prevalent diseases of the larynx that are the result of vocal abuse.

Myasthenia laryngis is a name applied by my co-author and me [1] to a morbid entity characterized by asthenia of the phonatory musculature of the larynx, especially the powerful overworked thyroarytenoideus muscles. It differs clinically from the ordinary fatigue of a muscle in that there is no tendency to prompt recuperation by rest and in that exercise does not strengthen the weakened muscle. It is a distinct morbid entity which has no connection whatever with myasthenia gravis.

In most of the textbooks laryngeal muscular disability is not mentioned, and in none is a distinction made between mucosal chronic laryngitis and disability of the phonatory musculature. Clergyman's sore throat is referred to the pharynx and even to the pharyngeal muscles, with no mention of the overworked intrinsic laryngeal phonatory muscles. Damage to the thyroarytenoideus muscles is nowhere recognized as the fundamental pathologic factor in the ruin of the great singer's voice.

INCIDENCE AND IMPORTANCE

The importance of a study of the condition as a distinct morbid entity derives from the following facts: 1. It is the condition that wrecks the careers of an enormous number of vocalists, actors, ministers and public speakers. In all these occupations it is the most common of all causes of disability. 2. It is one of the most frequent causes of chronic intractable hoarseness. 3. Failure to recognize it as the fundamental factor has led to endless disappointment in the treatment of vocal disability in all classes of users of the voice, including incorrigible conversationalists. 4. It is practically always mistaken for chronic laryngitis, which may or may not coexist.

Read at the Sixty-Second Annual Congress of the American Laryngological Association, Rye, N. Y., May 27, 1940.

1. Jackson, C., and Jackson, C. L.: The Larynx and Its Diseases, Philadelphia, W. B. Saunders Company, 1937.

It is a deplorable fact that of the promising young voices that start out for a career in vocal music about 95 per cent fail because the laryngeal phonatory mechanism will not stand the long, grueling ordeal of vocal training. It is my opinion that this high percentage of ruined voices could be reduced to relatively small proportions.

ETIOLOGY AND PATHOLOGIC MECHANISM

Atavistic Factor.—The phonatory function was imposed on the larynx phylogenetically late. To this has been added the imposition of the excessive incessant vocalization of modern human life, and in the case of vocalists there is additionally the ruinous abuse inherent in the attainment of the range, power and tone necessary for a musical career.

Predisposition.—In addition to the atavistic factor, there is a predisposition to myasthenia laryngis in some persons because of congenital or acquired faulty phonation that throws an undue load on the thyroarytenoideus muscle. Any form of debilitating disease or general ill health may be a predisposing factor.

Abuse of Voice.—This is the chief etiologic factor in myasthenia laryngis. It may be in the form of direct or indirect trauma. In either form the injury may be done by the degree of violence or by its duration.

Direct Trauma.—There is direct trauma in the phonatory contact of the cords and in the friction of the passage of the air current up between them. In quiet conversation with at least short intervals of silence the trauma is slight and its results are only a temporary vascular engorgement. In screaming, shouting, emphatic public speaking and in singing the direct trauma is much greater; it causes engorgement, often inflammation, rupture of the capillary wall and hemorrhage under or through the surface epithelium.

Indirect Trauma.—This may or may not be inflicted at the same time. Indirect trauma occurs when the intrinsic muscles of the larynx, especially the thyroarytenoidei, are imposed on with work that is excessive in degree or in duration.

The etiologic mechanism of myasthenia laryngis is closely connected with pitch.

Because of the systematized knowledge that has been built up for centuries around the art of music, it is most convenient to consider the larynx as a musical instrument; one can thus avail oneself of the systematized, standardized notation and of the accurate knowledge of vibratory cycles of definitely known frequency, hence definitely designated pitch.

It is universally known that spoken words may be totally devoid of any musical quality; yet any and every phonated word, syllable or

phonated sound of any kind necessarily has pitch, and pitch is constantly varied even in the most monotonous speaking voice. In my opinion the muscular work required by laryngeal sounds is an important factor in the causation and pathologic picture of that group of laryngeal ailments that are common not only in vocalists and public speakers but in all excessive users of the larynx, including the incessant conversationalist.

As a result of the studies reported here it seems logical to conclude that the higher the pitch the greater the strain on the two thyroarytenoideus muscles, each of which (right and left) has to bear the entire strain of the pull against the numerous and powerful guying muscles. It is true that the cricoarytenoidei laterales are also overworked, but their duty is more in the way of support; they do not have the strenuous work of accurate setting that is required of thyroarytenoidei, which are, so to speak, "out on the firing line."

From these facts it seems logical to conclude that the ruin of many young voices is due largely to the universal striving to raise the range of the voice to higher and higher pitches. It might be added that, as a general rule, the earlier in both life and training this ruinous striving is commenced the more ruinous it is.

In the deplorable laryngeal ruin of vocalists the primary fault is with the composers rather than with the teachers of vocal music. The trend for many years among composers of vocal music has been to write mostly for the upper range of the respective voices, so that teachers as well as pupils are forced to extend the upper range to the utmost. The worst feature of this trend is that the upper part of the voice is almost constantly called for instead of occasionally required.

The pitch of the individual singing voice ranges over about two octaves. A few great singers by long, hard practice have extended their range to three octaves.

The pitch of the speaking voice varies with the purpose of the speaker. Actors, orators, ministers, evangelists and other public speakers purposely use changes in pitch for dramatic, oratoric and emphatic purposes. The range is ordinarily more than an octave.

Singing and public speaking are, of course, not the only activities in which the thyroarytenoideus muscles are strained. Screaming, talking to the deaf, quarreling, cheering at football games and the like often result in myasthenia; but, unlike the professional singer, those who indulge in such vocal abuse do not keep it up long; an interval affords rest and cure. If they should continue, they, anyway, do not pay much attention to the vocal impairment, as does the professional vocalist, to whom it is a disaster. Hucksters, hawkers, drill sergeants, train announcers and similar abusers of the larynx usually keep on with a failing muscle until the voice is harsh, coarse and rasping.

A contributory factor in the causation of thyroarytenoid failure is incessant conversation. Most singers talk too much; that is to say, it is too much because it is in addition to their professional work. They give the larynx no rest.

The incessant conversationalist ordinarily uses a narrower range of pitch; indirect trauma in such cases is the result of excessive fatigue rather than of violence. Trained singers, in conversation, usually use a greater range of both pitch and intensity as compared to the vocally untrained.

Though usually due to vocal abuse, myasthenia laryngis may occur as a sequel of repeated attacks of myositis incidental to acute infective laryngitis. It also occurs as the sequel of hyperplasia in cases of chronic laryngitis; the hyperplasia in the edges of the cords destroys their elasticity and enormously adds to the work of the thyroarytenoideus muscles in shaping and compressing the glottic margins.

In cases of myasthenia laryngis the clinical history shows that there are often repeated attacks of excessive fatigue. It is also evident that often after excessively severe vocal abuse there is myositis. This usually low grade inflammation is always overlooked, because it is masked under the sensations of general laryngeal reaction to excessive vocal effort or of acute traumatic laryngitis, which are common to those who abuse the larynx.

Vocal nodules, organizing hematomas and other tumors may be etiologic factors by reason of the strain and extra load of work they impose on the thyroarytenoideus muscles in compensatory adjustment of the obstructed cordal approximation.

Arthritic impairment of mobility may similarly overload the thyroarytenoideus muscles.

Histopathologic data are meager, because the disease is never fatal, and removal of muscle merely for microscopic study has not seemed justifiable. However, some material has been available incidentally, and the results of its examination have been recorded.[1]

The pathologic conditions present with muscular strains in the accessible muscles elsewhere in the body are to some extent understood, though histologic changes apart from inflammation are often undemonstrable. With acute strains from overstretching, rupture of a few muscular fibers has been demonstrated; but with the myasthenias from prolonged overwork the histologic changes (other than atrophy) remain obscure.

ANATOMIC AND PHYSIOLOGIC CONSIDERATIONS

To get a proper conception of the cause of pathologic weakening of the laryngeal phonatory musculature it is necessary to consider the mechanism of the phonatory function of the larynx. Moreover, this seems all the more necessary because of the prevalent misconception of the underlying principles of this mechanism.

There has been so much imaginative theory on the entire subject that it is necessary to start with the fundamentals of phonetics and build up a new and correct conception of the phonatory mechanism of the larynx.

Misconceptions of Laryngeal Phonatory Mechanism.—The literature on the larynx seems based on a number of erroneous conceptions, the chief of which are these:

1. The assumption that laryngeal phonation is analogous to the tone production of a stringed musical instrument.

2. The assumption that changes in pitch are due to stretching of the vocal cords.

3. The assumption that the impact of the vibrating cord sets the air in vibration.

4. The assumption that the cricothyroid muscles create tension.

5. The assumption that the thyroarytenoid muscles are either laxors or tensors of the vocal cords.

6. Lack of realization of the enormous load of work that is placed upon the thyroarytenoid muscles. All laryngeal muscles are given equal consideration, as though each shared equally in carrying the burden.

7. Misunderstanding of the mechanics of changes of pitch.

8. The assumption that the larynx alone is concerned in changes of pitch.

9. The assumption that the tracheobronchial air column is not concerned in phonation otherwise than in supplying air and air pressure.

All of the misconceptions mentioned have led to fallacious reasoning and misunderstanding of the pathologic picture of one of the commonest and most intractable forms of chronic hoarseness; namely, that due to weakness of the thyroarytenoid muscles, to which my collaborator and I [1] have given the name myasthenia laryngis.

To get a proper conception of the phonatory mechanism one should regard the vocal cords simply as the calloused edges of the thyroarytenoideus muscles. Calling them "cords" has been deplorably misleading by creating the misconceived analogy to strings stretched for pitch. Persistent use of the word "cord" has been due to the illusion created by the shadow of the overhanging ventricular band, which on mirror examination simulates an outer line of demarcation that does not exist.[1]

Mechanism of Normal Phonation.—The elements in the mechanism of the human voice may be grouped under the following heads:

1. The vocal "cords."

2. The infraglottic, or tracheobronchial, air column.

3. The supraglottic air column.

4. The molds of speech.

The sounds produced by the vocal cords and emanating from the larynx are modified by two distinct mechanisms, the resonators and the molds of speech. The resonators reenforce certain tones; the molds of speech cut up and form the laryngeal sounds into words. These two mechanisms cooperate, and sometimes their respective actions antagonize, overlap or combine. For some sounds, S, for instance, they take over entirely the creation of the sounds, without any phonetic aid from the larynx. This applies to both the speaking and the singing voice.

Pitch.—The chief factor in producing changes of pitch in the human voice is the accurately controlled firming of the vocal cords under the action of the thyroarytenoid muscle. Supplementary factors are changes in (*a*) the size and shape of the glottis; (*b*) the dimensions of the infraglottic air column; (*c*) the size and shape of the supraglottic air column, and (*d*) the tracheal air pressure.

The larynx is essentially an air column instrument. The loudness of the human voice would be impossible if it depended solely on the aerial impact of the vibrating cords. The action of the glottis is to cut the expiratory blast of air into little puffs, which in turn set into vibration the entire resonating air column above and below the glottis.

The frequency of cutting of the passing air coincides with the vibratory frequency relative to the unit of time, or, in a word, pitch.

Along with the fundamental note produced at the glottis are numerous partial notes, probably twenty or more. The upper partial notes are overtones. The fundamental note is reenforced by the resonators, above and below the glottis; the partial notes may be reenforced, suppressed or eliminated, giving character to the voice, but the fundamental note is ordinarily little changed in pitch by the resonators.

All of these changes in the glottic aperture necessary to change the pitch of the fundamental note are produced by the thyroarytenoid muscles (figs. 1, 2, 3 and 4). For the thyroarytenoidei to act efficiently in shaping the glottic aperture and in hardening its margins they must have rigid fixation at their bases, and the slack must be taken up in the cords. These two actions, the fixation and the taking up of the slack, are the functions of the cricoarytenoidei postici, the cricothyroidei, the cricopharyngeus and, to some extent, all the anterior muscles of the neck, the last-mentioned group contributing a mite when powerful fixation for high notes is required. The action of the thyroarytenoidei, the cricoarytenoidei laterales and the arytenoideus, if unresisted, would have an orbicular effect on the glottic aperture. It is against this effect that the guying is necessary. Though at first thought the guying and the taking up of slack might be called a stretching of the cord, it is

really a preparation to resist counterpull. It is nothing like the breaking strain that would follow any attempt to raise pitch two octaves by stretching, as of a guitar string.

The guying and fixation immediately precede the orbicular action (figs. 1, 2, 3 and 4). The mirror appearances of the normal larynx on which these statements are based are described under the head of diagnosis.

In all this muscular action there must be perfect timing and perfect teamwork to produce a good fundamental note.

The terms orbicular and divergent, or guying, must not be taken as synonymous with adductor and abductor. They constitute a different

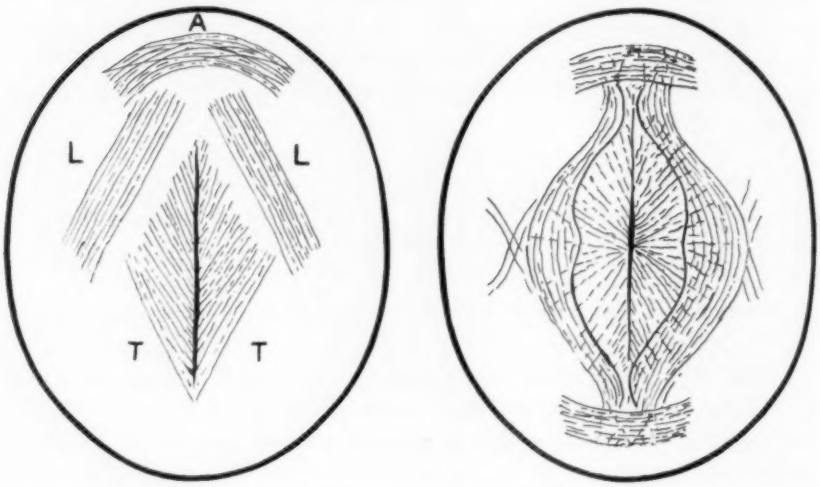

Fig. 1.—Schema of the orbicular group of phonatory muscles. It is obvious that the simultaneous contraction of the interarytenoideus (*A*), the cricoarytenoidei laterales (*L, L*) and the thyroarytenoidei (*T, T*) would close the larynx orbicularly if their action were unresisted. Such action does take place in swallowing, but in phonation the orbicular effect is prevented by opposition of the guying group of muscles (fig. 2). It should be noted that the thyroarytenoidei really constitute the so-called "vocal cords." At the right, above, is schematically shown the orbicular group of muscles in the lips. It is noteworthy that the lips are made up chiefly of fibers of the orbicularis oris, analogous to the thyroarytenoid in the "vocal cord." For the purpose of illustrating the anology between the action of the lips of the cornetist and the phonatory laryngeal mechanism the drawing of the lips is turned to bring the long axis of the lips vertical.

grouping of muscles and refer to a new conception of the mechanism of phonation.

The details of shaping of the glottic margins are important, but they have not been stated in the foregoing paragraphs, for two reasons. First, they are well known, and secondly, to restate them here would

subtract from the clarity and emphasis that, in my opinion, should be placed on the simple open-and-shut mechanical principle that is fundamental to laryngeal phonation. Unquestionably the shaping of the glottic margins adds enormously to the burden of work thrown on the thyroarytenoideus muscle, and thus it contributes to the causation of myasthenia laryngis.

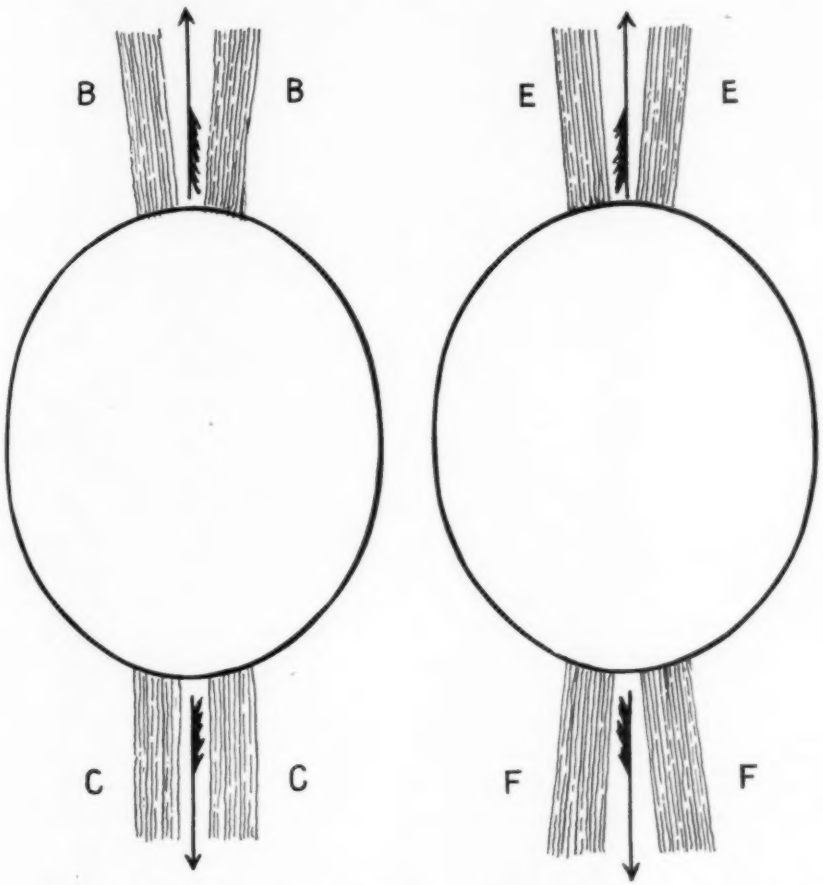

Fig. 2.—Guying musculature of the larynx. The cricoarytenoidei postici (*B, B*) pull backward and the cricothyroidei (*C, C*) pull forward, as indicated by the respective darts. At the right is shown the analogous group of guying muscles of the cornetist's lips, the buccinnator, zygomaticus, risorious, levator and depressor anguli oris of the respective right and left ends of the lips (*E, E; F, F*). The drawings are schematic and are intended to show the direction of muscular pull rather than the exact anatomic position.

The Human Air Column.—Study of the sound-producing mechanism of various wind instruments shows that changes in the air column are essential for this kind of instrument. To produce notes of more than

five distinct pitches a change in length is necessary, and in some instruments, such as the pipe organ, the diameter of the air column is also changed. Obviously a study of the human air column is essential for understanding of the phonatory mechanism.

As a broad generalization it may be stated that persons with high-pitched voices, such as sopranos and tenors, have short necks, whereas

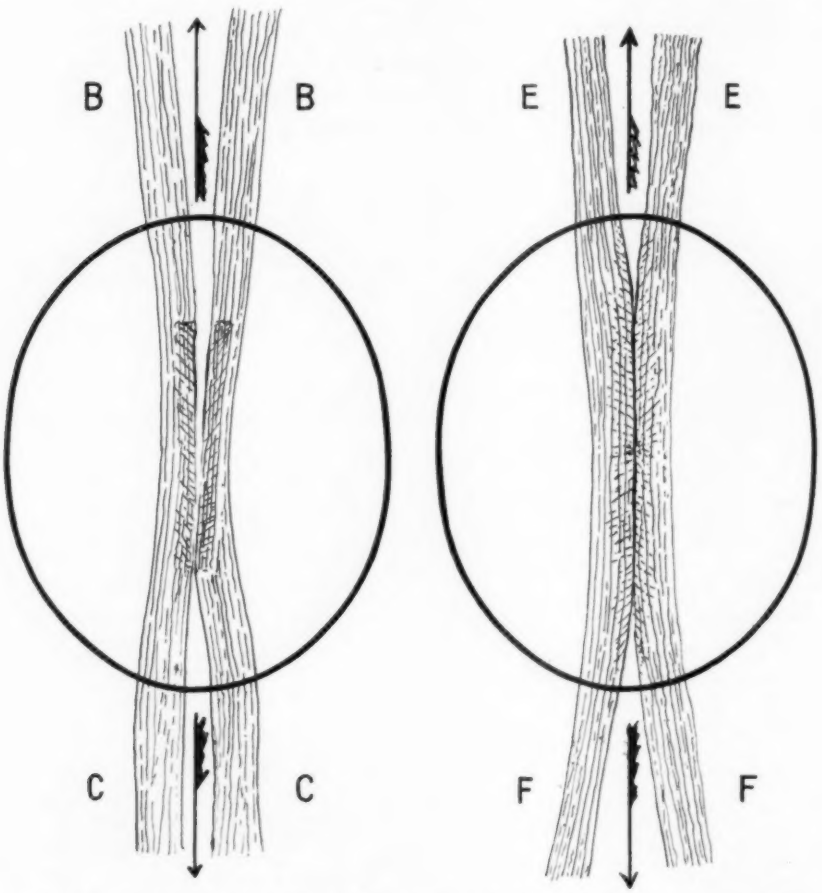

Fig. 3.—At the left is indicated the action of the guying muscles (*B, B* posteriorly, and *C, C* anteriorly), in getting set to resist the oncoming pull of the orbicular group. The result of the set is to take up the slack in the "cords" and not only to fix their ends to resist the orbicular pull but to prevent an orbicular effect. At the right is shown the analogous preliminary set of the guying group of muscles (*E, E; F, F*) of the cornetist's lips (*cf.* figs. 6 and 7). As in the larynx, the guying set precedes the orbicular action; but the interval between the two movements is longer and more readily detected because the movements are voluntary.

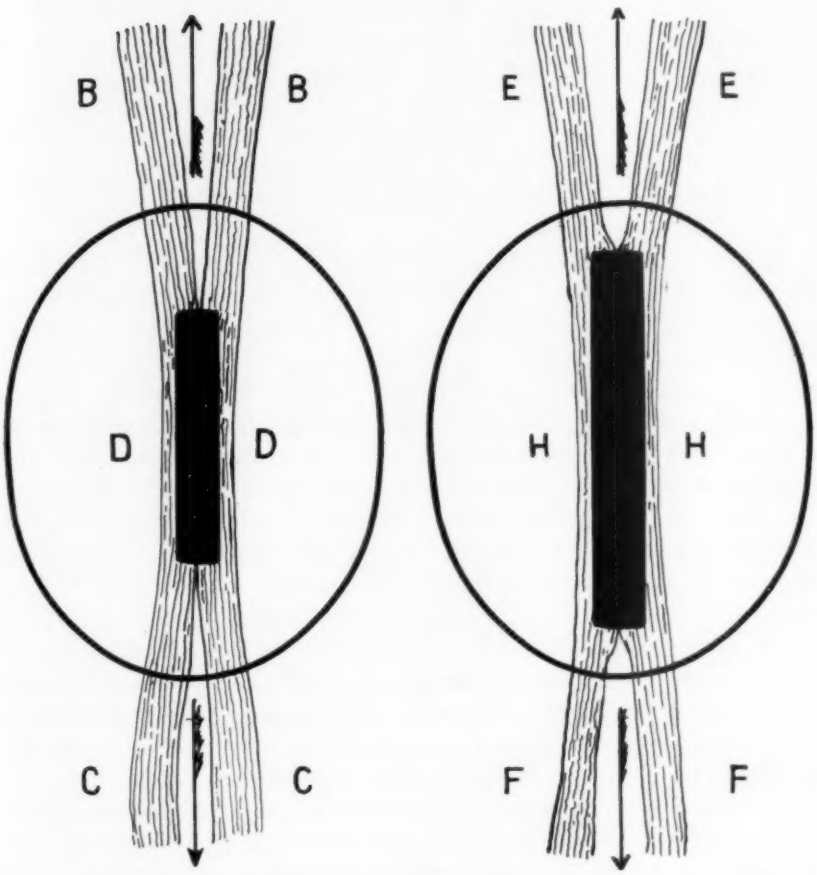

Fig. 4.—In a fraction of a second after the set of the guying group of muscles as shown at the left in figure 3, the orbicular group come into action. They cannot produce their orbicular effect because of the sagittal set of guying muscles. With the countertractive fixation of this set, the thyroarytenoidei firm the edges of the approximated "cords" as indicated by the black area (*D, D*). The thyroarytenoidei being inserted into the cordal edges, bear the load of the work, though they are supported by the tightly contracted laterales. The firmed, tightly approximated edges of the cords are ready to be blown apart by the upcoming blast of air from the tracheobronchial air column. They will promptly close, cutting the air into a puff, and this will be repeated with a frequency corresponding to the cycle of the pitch of the note produced. The firmer the compression of the orbicular musculature the quicker the closure; hence the greater the frequency and consequently the higher the pitch. At the same time as firming of the edges of the "cords" occurs, there is a change in the shape and location of the aperture for passage of air, and there is also a change in the size and shape of the cross section of the "cords." The cords are thinner and the base of the triangular cross section is diminished as pitch rises. At the right is indicated the analogous action of the cornetist's lips (*cf.* figs. 6 and 7).

those with relatively low-pitched voices have longer necks. This would indicate that a long trachea with a presumably longer air column lowers the pitch of the voice. There are enough exceptions to this generalization to call for further study. It is true that a longer neck might mean only that more of the tracheal length is in the neck and correspondingly less in the chest, with the total length the same as in a short-necked person. My observations indicate that this is rarely the case and that the generalization mentioned is applicable as a rule to which there are relatively few exceptions.

It seems to be an unquestionable fact that no study of physiologic phonetics can be complete without consideration of the human air column extending from the vertical plane of the lips and nostrils to a level at least as low as the orifices of the bronchi of the lower lobes of the lungs; it is more than 36 cm. in length. The vibration of the air column certainly extends even below this point, but how far and to what degree it vibrates are important points that have not yet been determined. The nasal resonating cavities have been extensively considered in the literature, but the phonetic changes in dimensions of the supraglottic air column have received little consideration, and the phonetic influence of dimensional changes in the tracheobronchial air column seem to have been totally ignored.

As to the dimensions of the tracheobronchial air column, cadaveric measurements are not even approximately applicable, because of constant changes in dimensions in the living; such changes are of themselves of fundamental importance in phonetics and under normal conditions probably play a part in the human phonetic mechanism.

Fortunately there is an abundance of data on dimensions of the tracheobronchial tree in the living, obtained from bronchoscopic observations on thousands of patients examined because of various clinical indications for the procedure (fig. 5).

The following comments are quoted from a recent bronchologic textbook [2]:

> While the lumina of the individual bronchi diminish as the bronchi divide, the sum of the areas shows a progressive increase in total tubular area of cross section. Thus, the sum of the areas of cross section of the two main bronchi, right and left, is greater than the area of cross section of the trachea. This follows the well-known dynamic law. The relative increase of surface as the tubes branch and diminish in size increases the friction of the passing air, so that an actual increase in area of cross section is necessary, to avoid increasing resistance to the passage of air. . . . In considering the foregoing table (of tracheobronchial dimensions) it is to be remembered that in life muscle tonus varies the lumen and on the whole renders it smaller. . . . The *normal movements of the trachea and bronchi* are respiratory, pulsatory, bechic, and deglutitory. The two former are rhythmic while the two latter are intermittently noted during bronchoscopy. It is readily observed, bronchoscopically, that the bronchi elongate and expand

during inspiration; during expiration they shorten and contract. . . . At every bronchoscopy elongation and shortening of the bronchi is seen to cause a certain point, for instance a spur between orifices, to recede from the tube mouth on inspiration and to approach it on expiration. . . . There was an excursion of the bronchus longitudinally (elongation and shortening) of about 2 cm. between maximum inspiration and maximum expiration.

It seems to me evident that these wide changes of dimensions of the air column when under trained control must have an important bearing on human phonetics. So far as resonating function is concerned, the influence would be chiefly on quality of tone and to a slight degree on intensity; but it is to be noted that resonators, by reason of reenforcement and suppression, are not altogether without influence on pitch.

The fundamental laws of phonetic vibrations in confined air columns germane to the present subject are these:

1. The pitch of air vibrations in a tube varies inversely as the length of the tube.

2. The pitch may be somewhat affected by changes in diameter of the tube.

3. An open tube gives a fundamental tone an octave higher than that of a tube of the same length with one end stopped.

The foregoing statements are accepted laws of physics. Additionally, my experiments with oboe reeds lead me to believe that the pitch of a reed and the pitch of a tube, as sounded separately, are each different from the combined pitch of the two when sounded simultaneously.

The supraglottic air column may be classed as an open tube. The infraglottic air column is a tube stopped at its lower end, but its relation to the source of the fundamental note is different.

As it is the air that vibrates and not the walls, the fact that the walls containing the human air column are of living tissue does not render these laws inapplicable. The walls during phonation become rigidly fixed; the higher the pitch, the greater the rigidity. This is plainly visible in the pharynx of the singer.

In the study of the mechanism of phonation it becomes evident that the human air column should be divided into supraglottic and infraglottic parts for separate consideration, not merely for anatomic reasons but because of the fundamental difference of location in relation to the primary factor in sound wave production, namely, the vocal "cords."

The Infraglottic Air Column.—Many authorities have stated that the trachea does not participate in phonation except as a tube to convey air. This erroneous opinion is based on theoretic considerations. It is true that the air column is not set in vibration until the cords vibrate, but it is an error to infer that the vibrations affect only the outgoing supraglottic air column. When an air column is set in vibration all parts of the column participate, though, of course, not equally. More-

over, my experiments with oboe reeds lead me to believe that the pitch of a reed is affected by a tube on either side of it.

A study of the physics of phonation renders it evident that the infraglottic air column acts as a resonator and that as such it reenforces the laryngeally produced sound. Moreover, by reenforcing the fundamental note or the partial notes it may influence pitch, at least to some extent.

Of course, the pressure of the infraglottic air column is a large factor in production of pitch. The pressure increases progressively as the pitch is raised and for the upper range becomes relatively enormous. This pressure itself inflicts direct and indirect trauma on the thyroarytenoideus muscles. The direct trauma is inflicted on the thyroarytenoideus, whose fibers on the glottic margins are only slightly covered. The indirect trauma is caused by the violent muscular contractions incidental to the valvular control duty of the thyroarytenoidei. This is in addition to the indirect trauma of phonation. This increase of infraglottic air pressure is analogous to the overblowing for pitch in inanimate air column instruments.

Histologic examination reveals few muscular fibers in the membranous posterior wall of the trachea. They are present in the bronchial wall. But any action of this musculature is of relatively less influence on the diameter of a cross section of the tracheobronchial tree than are the changes of air pressure due to the bellows-like action of the chest as a whole. At bronchoscopy one is constantly aware of the diminution of the tracheal lumen due to the mounding of the membranous posterior wall. It is most conspicuous during cough [2] but is noticeable in varying extent at every expiration. It appears to be partially an active and partially a passive movement.

The dimensions of the infraglottic air column have been referred to.

Variations in the lumens of the bronchi independent of phonation have been carefully studied in a series of researches by Ellis and Livingston [3] and by Ellis.[4]

In order to get anatomic and tomographic data on variations in the length and diameter of the infraglottic air column I have asked Dr. W. Edward Chamberlain to make fluoroscopic and tomographic studies on the movements of the tracheobronchial tree in relation to pitch of the singing voice dissociated as far as possible from the movements of respiration, vowel enunciation and the molding of words.

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2. Jackson, C., and Jackson, C. L.: Bronchoscopy, Esophagoscopy and Gastroscopy, ed. 3, Philadelphia, W. B. Saunders Company, 1934.

3. Ellis, M. P., and Livingston, A. E.: A Method of Directly Recording Changes in the Calibre of the Bronchi, J. Physiol. **84**:223, 1935.

4. Ellis, M. P.: The Function of the Bronchial Tubes, Lancet **1**:819, 1938; The Mechanism of the Rhythmic Changes in the Calibre of the Bronchi During Respiration, J. Physiol. **87**:298, 1936.

The Supraglottic Air Column.—This column is shortened for high-pitched notes to an extent that is small compared to inanimate air column instruments. The difference is compensated for to a slight extent by diminution of the diameter of the lumen of the trachea but to a very large extent by great efficiency of the phonatory muscles, especially the thyro-arytenoidei.

My observations lead me to believe that, though the thyroarytenoideus muscles with the assistance of the guying muscles do most of the work in varying the pitch, it is erroneous to assume that all changes in pitch are produced by the larynx alone. Substantial aid is received from changes in the supraglottic and infraglottic air column. For reasons previously mentioned, I believe that the pitch of the cords, acting as reeds, is different from the tubal pitch of the whole human air column, and the pitch of the two sounded simultaneously is different from the pitch of either sounded alone.

The narrowing of the laryngeal part of the supraglottic air column as the pitch is raised is seen in the mirror to be produced by (*a*) a movement of the ventricular bands toward the median line and (*b*) a rise of the epiglottis, dragging the aryepiglottic folds toward each other. This narrowing of the laryngeal part of the supraglottic airway is accomplished by the contraction of (*a*) the thyroarytenoidei and the laterales, which raise the floor of the ventricle; (*b*) the arytenoideus and (*c*) the aryepiglottici, which, together with (*d*) the raising action of the crico-arytenoidei, narrow the laryngeal vestibule. It is true that, as has been stated by Negus,[5] phonation does not require an epiglottis, but my observations of the throats of singers during phonation leads me to believe that the presence and controlled changes in shape of the epiglottis have an important part in the effect of the supraglottic air column on pitch. This effect is chiefly exerted on the diameters of the vestibular part of the column.

The pharyngeal and faucial part of the supraglottic air column is narrowed progressively as the pitch is raised. As to the mechanism by which this is produced, palpation of my own neck while sounding notes of about one and one-half octaves interval and endopharyngolaryngeal examination of singers over the full ranges of their respective voices have led to the following conclusions:

When the lowest note is sounded: (*a*) the larynx descends about 1 cm.; (*b*) the hyoid bone moves forward about 7 mm. and downward about 5 mm.; (*c*) the entire tongue descends relatively to the top level of the lower teeth; the descent is slight at the tip, but at the dorsum it amounts to more than 1 cm.; (*d*) the lower border of the soft palate

5. Negus, V. E.: The Mechanism of the Larynx, St. Louis, C. V. Mosby Company, 1929. (A classic on the comparative anatomy and physiology of the larynx.)

drops to its lowest relaxed position, and (*e*) the mandible drops in proportion to the opening of the mouth.

In contrast with these movements, when a note of highest pitch is sounded the following changes take place: (*a*) The larynx rises about 1 cm. and moves slightly forward; (*b*) the hyoid bone rises, but slightly less than the larynx (consequently the thyroid cartilage approaches the hyoid bone); (*c*) the tongue rises and moves backward toward the posterior pharyngeal wall so as to diminish the airway to a lumen as small as 2 mm. in some persons; (*d*) the muscular part of the pharyngeal wall becomes rigidly fixed at a position that has a definite relation to the pitch of the note uttered, and (*e*) the uvula and palate move apparently in relation to the particular demand on the nasopharynx and nasal chambers as resonators.

The extralaryngeal muscles modifying the size of the supraglottic air column are as follows: (*a*) the extrinsic and intrinsic muscles of the tongue, which change its shape and position; (*b*) the geniohyoid muscles, which raise the hyoid bone and with it the larynx and draw downward the mandible; (*c*) the mylohyoid, omohyoid, digastric and sternothyroid muscles; (*d*) the pharyngeal constrictors and the cricopharyngeus muscles, and (*e*) the faucial and palatal muscles.

All the aforementioned muscles not only participate to some degree in influencing the size and shape of the supraglottic air column, but, together with the cricopharyngeus muscle, they help the guying, fixing muscles of the larynx to resist the orbicular muscles (fig. 1). They do not help the thyroarytenoideus muscles, which take all the burden of laryngeal vocal pitch control.

The adult air column from the glottis to the lips, sounding the vowel sound "ah" at a pitch of C-128, measured along its median axis 15.3 cm. In sounding the same vowel sound at a pitch of A-427, the supraglottic air column measured 13.2 cm. along its median axis. This represented a shortening of the supraglottic air column of 2.1 cm. (14 per cent). The measurements were taken with a bent laryngeal probe held clear of contact under guidance of the mirror. Mucosal anesthesia was used.

The diameter of the lumen of the supraglottic airway is so irregular in different parts that the diametric measurements were made only at one point, the narrowest. This is located between the greatest convexity of the tongue and the posterior pharyngeal wall. At this point (*SD*, fig. 5) the lumen, in a group of singers trained to keep the mouth widely open, on the average diminished in sagittal diameter from 5 mm. at the lower note to 2 mm. at the higher note. This represents a diminution of 60 per cent, but it is subject to a large equation of variation, because, though the shape and size of the supraglottic air column are unchanged in the nasal and accessory sinal resonating cavities, in all other parts its size and shape vary in molding different words. In these other parts the relatively minor influence on pitch is subordinated

to the necessities of molding speech. There is also a variable due to formation of the different vowels.

Clinical evidence of the influence of the supraglottic air column on pitch is the low-pitched voice associated with laryngoptosis.[1]

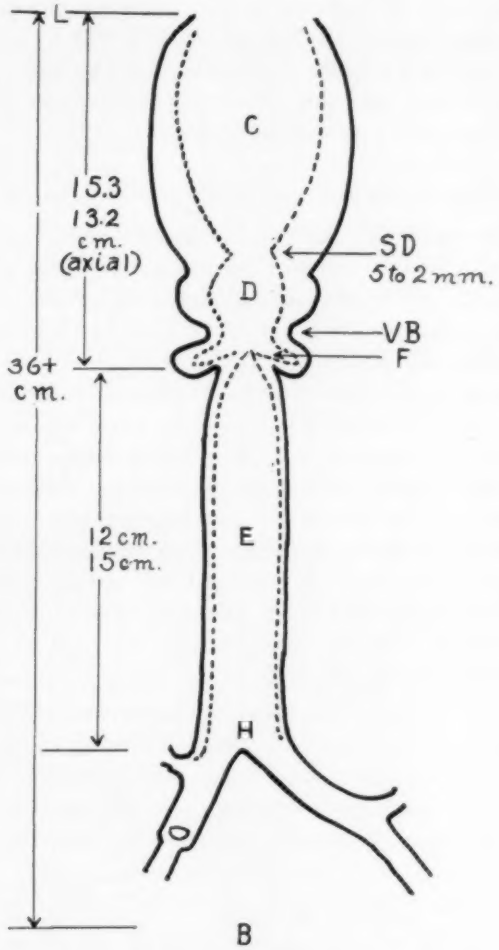

Fig. 5.—Schema of the human air column with estimates of varying dimensions during phonation. *C*, oral cavity, pharynx and fauces; *D*, vestibule of the larynx; *VB*, ventricular bands; *F*, ventricle; *E*, trachea; *B*, bronchial tree; *SD*, maximum narrowing for high pitch; *L*, horizontal plane of the lips. The measurements of the supraglottic air column were taken with the mirror on the living and are necessarily variable not only individually but also functionally in the same person. Cadaveric measurements are poor criteria for determining the functional dimensions in the living. The functional variation in dimensions of the trachea were noted bronchoscopically independent of phonation. These are subject to revision after the roentgen studies of Dr. W. E. Chamberlain on the phonetic variations of the infraglottic airway shall have been completed.

Perhaps a 15 per cent change of dimensions of the supraglottic air column would be a fair estimate of its contribution to pitch.

Myasthenia Laryngis in Voice Users Who Do Not Sing.—For convenience pitch is referred to in connection with the musical scale, because it enables one to take advantage of the systematized, universally understood musical notation on the scale. This may give rise to the false impression that myasthenia laryngis is seen only in singers. To correct this error it is only necessary to remember that the word pitch may be used simply to designate the frequency of the vibratory cycles regardless of whether the quality of the sound is musical.

THE LARYNX COMPARED TO INANIMATE MUSICAL INSTRUMENTS

From the point of view of mechanism there are three groups of musical instruments: (*a*) percussive instruments; (*b*) string instruments, and (*c*) air column instruments. Each of the groups sets the surrounding air in vibration, but the mechanism by which this is accomplished differs widely.

Percussive instruments may be omitted from discussion here, as no scientist has ever attempted to draw any parallel between them and the human voice. Practically all other instruments have been thus compared, and each player in the orchestra is prone to consider his instrument as most like the human voice in its tonal quality.

Stringed instruments produce a tone by setting the surrounding air in vibration as the result of a to and fro motion of a string. But the string is so slender that its lone effect on the surrounding air would be feeble; therefore the vibrations, partial as well as fundamental, are reenforced by a broad sounding board with a large surface contact with the air. The pitch of each string is raised to the tension necessary to produce the exact number of vibrations for its assigned note. Pitch is further raised by stopping, except in the case of the harp and the piano. For efficiency thicker strings are necessary for the slower cycles of low-pitched notes and thinner strings for the high frequency of the vibratory cycles of high-pitched notes. Though the height of pitch is inversely as the length and thickness of the string, the fundamental mechanical factor in the sound produced by stringed instruments is stretching. The tensile stress on the tailpiece of a Spanish guitar tuned relative to A-440 is approximately 180 pounds (81.7 Kg.). The area of the top sounding board is approximately 200 square inches (1,290 sq. cm.). If it were not for this sounding board the vibrations of the guitar would be inaudible beyond a few feet. There is a contained resonating body of air, but it is not subject to variations of pressure or to dimensional changes in the walls of the container.

There certainly is nothing in the laryngeal mechanism analogous to a tensile stress of 180 pounds or to a sounding board with an area of 200 square inches.

It is a physical impossibility to produce notes as deep in pitch as a bass voice by a string no longer than a vocal "cord," no matter how much it is relaxed.

Air Column Instruments.—In all instruments of this class the column of air contained in a tube is set in vibration, and this column of vibrating air in turn controls the vibrations and imparts them to the surrounding atmosphere. The mechanism of production of the fundamental note differs. In the flute the initial vibrations are created by the impinging of an air current on a sharp edge. In the organ, clarinet, saxophone and oboe the initial vibrations are created by a reed activated by a passing air column, which the reed cuts into little puffs of air succeeding each other at a frequency corresponding to the pitch of the note produced.

In each of these subgroups the fundamental note is reenforced by a suitable length of air column which drowns out the unwanted partial tones that are produced along with the fundamental note. In a third subgroup the initial fundamental note is produced by vibration of the lips of the player. The mechanism of a representative of each of these subgroups requires consideration.

Flute: The flute was mentioned by Galen and many later authors as resembling the human voice. Its fundamental note, produced by impinging of a small jet of air on a sharp edge, has no analogue in the larynx. The cords are inclined upward, so that the outgoing air could not impinge on their edges, and there is nothing in the human anatomic structure to compare with the seventeen side outlets in the air column of the flute, required for changes of pitch. The same is true of the piccolo, which is an octave higher than the flute, the higher pitch being obtained by reduction in the diameter and length of the air column.

Organ: An organ pipe by means of a fixed length and diameter picks out from a reed-generated note the fundamental note, certain partial tones for reenforcement and certain others for suppression. Each note requires its own particular size of pipe.

There is nothing in the human larynx analogous to an organ reed, and to be analogous to the organ the human larynx would require a pipe about 5 feet (1.52 m.) long to sound the lowest note of the human voice (80 cycles).

Oboe: The hautbois is the only reed instrument worthy of consideration here. The fact that, in principle, the oboe consists of an air column set in vibration by two reeds has misled many physiologists and even laryngologists into regarding the oboe as the instrument most nearly resembling the human voice in phonetic mechanism. Superficially the

presence of two reeds invites comparison to the two vocal cords. This error has become more deeply fixed in the mind of the physiologist because of the fact that the quality of the human voice can be closely simulated by the skilful oboist. For example, the pitiful cry of a child can be simulated so closely as to deceive any one within hearing distance. The corno Inglese, an oboe transposing a fifth lower, is called by the Italians *"umana voce,"* meaning human voice.

The assumption of similarity of the oboe and the larynx is not supported by physical examination of the respective phonetic mechanisms. The phonetic principles of the oboe differ widely from those of the human voice. The reeds of the oboe are of wood (cane), and the instrument is almost entirely dependent on changes of length of air column for changes of pitch.

It is true that the oboist can vary pitch to a limited extent by variations of air pressure. It is also true that the expert oboist can by scraping make some slight modification of the reed, but it still remains wooden in every sense of the word. It is incomparable to the living human vocal cord, whose marvelously intricate and delicately controllable changes in vibratory mechanism are instantly available by action of the thyroarytenoideus muscle. This wonderful muscle enables the vocalist to produce at will every one of the notes of two octaves of the chromatic scale, whereas to obtain such changes of pitch the crude wooden reeds of the oboe require about eighteen supplementary changes in length of air column as well as variations in air pressure. There is nothing in the human air column analogous to the eighteen or more finger-controlled side outlets of the air column of the oboe.

These facts render evident the error of the physiologists who have compared the human larynx to the oboe. All the foregoing statements apply also to the bassoon, which has a double reed, and to the clarinet, which has a single reed.

These facts also afford an excellent illustration of the enormous load of work inflicted by voice users on the marvelous thyroarytenoid muscles, which do the work with relatively little help from variations in length of air column.

Bugle: The bugle is essentially a tube containing a column of air about 160 cm. long. It has no reeds, no valves and no keys. The contained column of air is set in vibration by the lips of the player applied to the proximal end. Changes of pitch are produced by the lips of the player, aided by slight differences in air pressure. The lips are placed across the mouthpiece in such a way that they vibrate when air is forced through them.

Many bugle players are under the impression that they stretch the lips proportionately to obtain the higher notes. Careful observations of my own lips while playing the bugle and the cornet, with a transparent

mouthpiece, have convinced me that this is an error. The lips are firmed and compressed progressively more and more with each rise of pitch. Some bugle players believe that as they progressively draw the corners of the mouth backward they thus step up the pitch by stretching. But to obtain upper G (768) by stretching would require a tensile stress of many pounds. Obviously the human lips would be torn and severe pain would be inflicted by any such degree of stretching, if it were possible to apply it. A study of my lips in playing the bugle and the cornet in the light of anatomic studies reveals a firming mechanism that is analogous to the laryngeal pitch mechanism described in a foregoing section.

The human lips are composed of complicated layers of muscle covered externally by skin and internally by mucosa. The muscular mechanism employed in playing the bugle or the cornet is a combination of compressive closure of a powerful circular musculature preceded and opposed by longitudinal traction of two powerful sets of diverging muscles which when they contract guy and fix the corners of the mouth so as to resist the pull of the orbicularis muscle (figs. 1, 2, 3 and 4).

The fibers of the orbicularis muscle pass into both the upper and the lower lip in a way that is closely analogous to the insertion of the fibers of the thyroarytenoideus muscles into the "cords." The action of the two musculatures, on the vocal "cords" and on the lips respectively, is remarkably similar.

The muscles of the lips and their actions are presented in the schemata (figs. 1, 2, 3 and 4). The muscles may be divided into the circular fibers and the opposing divergent muscles. The orbicularis is not an isolated muscle; it is really a large circular interlacing of the inner ends of the two lateral sets of diverging radial muscles. Each lateral set of muscles consists of the buccinator, risorius, levator anguli oris, zygomaticus, depressor anguli oris and depressor labii inferioris. The action of the orbicularis, if unresisted, circularly contracts the lips as in whistling. To prevent this circular contraction the bugler or cornetist guys back the corners of the mouth so as to give peripheral fixation for the fibers in the lips, converting the lips into vibrating bands approximately analogous to the firming of the edges of the vocal cords. The higher the pitch required, the firmer the edges of the lips are made. This tone-producing mechanism of the lips is shown in figures 1, 2, 3, 4, 6 and 7.

The foregoing statements are not theory but the result of observation of my own lips and facial muscles in the placements required to produce notes of the whole range of pitches on the bugle and the cornet. Observations of my lips were made with the mirror and with the transparent mouthpiece, and these observations were carefully checked with the subjective sense of the action of the respective teams of muscles.

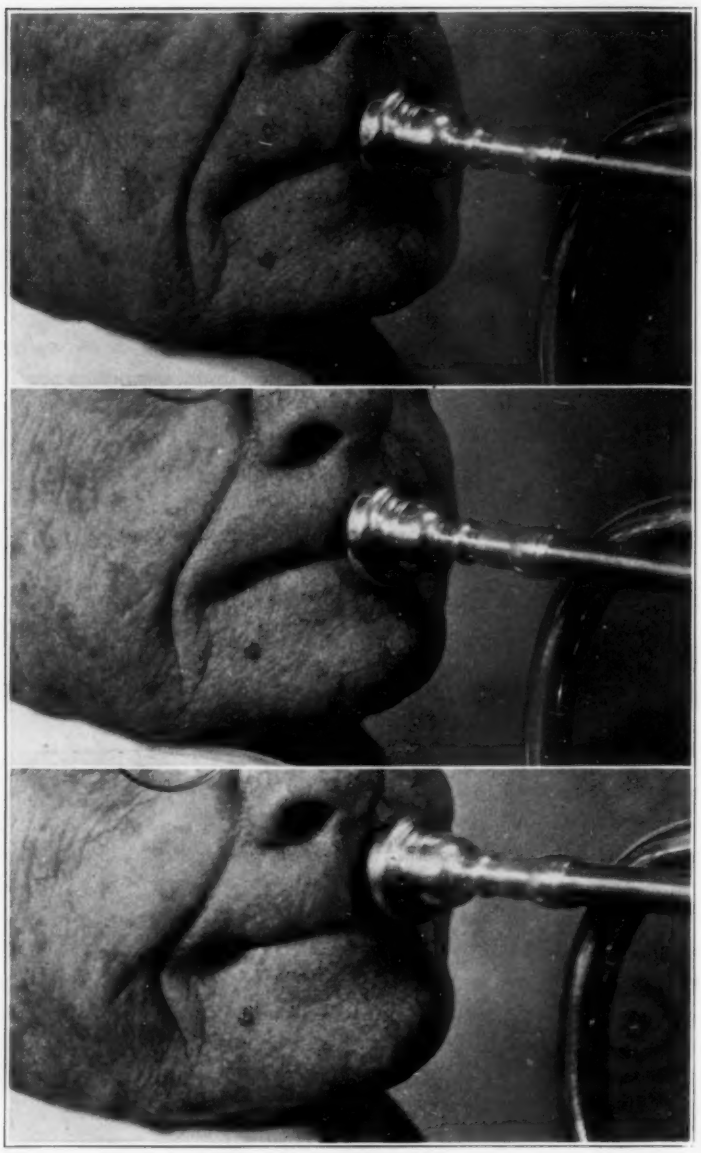

Fig. 6.—Embouchure of a cornetist, illustrating the analogy between the phonetic mechanisms of the cornet and the human larynx, respectively. The upper illustration shows the moderate set of the guying muscles (*cf.* figs. 1, 2, 3 and 4) for C-256, which was quickly followed by moderate firming of the lips. The intermediate photograph shows the stronger guying and firming to produce the note C-512. The lower illustration shows the still greater guying and firming necessary to produce the note G-768.

The bugle has only five isolated notes; it is incapable of producing the diatonic intervals, because it has a tube of fixed length and fixed diameter. To get all the intervals in the chromatic scale seven changes in tube length would be necessary. Changes in diameter are not to be considered, because they are mechanically impracticable in brass musical instruments.

Cornet: In principle the cornet is the same as the bugle. It is essentially a confined column of air set in vibration by the lips of the cornetist. It has no keys, no reeds and no means of creating a fundamental note. It differs from the bugle in having three valves that allow the player quickly to make seven changes in tube length. These changes in length of air column enable the player to sound all the notes of the chromatic scale.

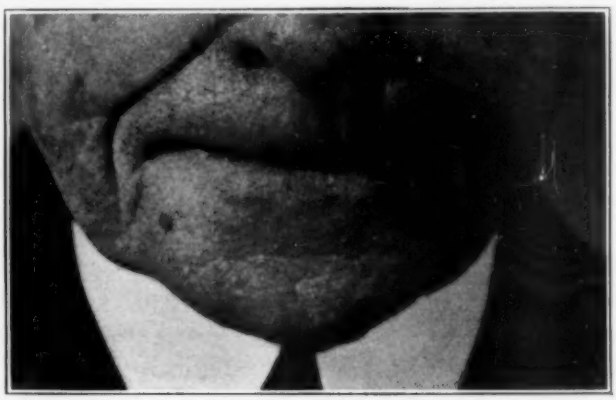

Fig. 7.—Embouchure of the cornetist for production of the note G-768 (*cf.* fig. 6). The guying muscles have drawn the lips out into two bands in preparation to resist the circular action of the orbicularis. With this longitudinal extension and the accompanying fixation the contraction of the orbicularis has firmed and compressed the margins of the aperture to be blown open between the lips. The length of the aperture is controlled for pitch, as is the glottic chink.

In the phonetics of the cornet there is a close analogy to the phonetics of the human larynx, closer, it seems, than has been heretofore realized.

If one breathes through the cornet, just as in breathing through the larynx, practically no sound is produced. The cornetist must set the tube-contained column of air in vibration. This he does with his lips, just as the column of air in the human air passages is set in vibration by the vocal cords. The analogy goes still further. Before the cornetist sounds a note he guys the corners of the mouth to resist the orbicular effect of the orbicularis muscle (figs. 2, 3, 4, 6 and 7) by holding the lips elongated, in a position similar to that of risus sardonicus. Then the orbicularis, thus guyed, contracts, compressing and firming the edges

of the lips, into which the fibers of the orbicularis muscle are inserted. The degree of firming of the lips is progressively greater in proportion to height of pitch of the note, which means frequency of the cutting of the air column into separate puffs. The cornetist must learn by practice how to set the lips for each absolute pitch, just as the vocalist must learn to set the laryngeal musculature for each absolute pitch. Both the guying and the firming of the edge must be relatively and totally in accurate proportion to the pitch of the note to be produced. The highest as well as the lowest useful musical notes can be obtained by these variations of the lips without any change in length of the contained air column, though there is a helpful increase of air pressure, known as overblowing. But the musculature of the lips, being a cruder mechanism than the musculature of the larynx, has not the refinement of mechanism to produce all the intervening tones and halftones; a change of length of the air column is necessary to supplement the labially created vibrations. In laryngeal phonation the exquisitely refined and beautifully controllable action of the thyroarytenoideus muscle supplies all these intervals of the chromatic scale with relatively small changes in dimensions of air column. There is, however, a helpful rise in air pressure in the infraglottic air column that is analogous to overblowing for raising of pitch with the cornet or the bugle. It may be added that there are changes in the length of aperture between the lips, with changes of pitch, that are closely analogous to those of the glottic chink.

In the cornet a range of approximately 37 per cent (from 193 to 142 cm.) in tubal length is necessary to get these intervening tones. As was explained in a preceding paragraph, there is a change in dimensions of the human air column, estimated at 15 per cent. This is a fair criterion of the tremendous load of work thrown on the thyroarytenoideus muscles. In all ordinary conversational use of the voice, pitch is largely produced in the larynx, chiefly by the thyroarytenoideus muscles, with relatively little aid from change of dimensions of the air column. For high pitches, trained singers employ a relatively greater change of these dimensions.

The bell of the cornet is included in the tube length and is analogous to the wide open mouth that all trained vocalists use.

For the sake of clarity only the cornet is mentioned in the foregoing comparison. The basic principle is the same in all reedless horns. The trombone has a range of tubal length of 107 cm. obtained by a slide placed at will in any one of seven different positions, giving the change of length of air column necessary for producing the intervening notes of the chromatic scale.

Tiring of the Lip of the Cornetist (Myasthenia Labialis).—Every wise orchestra leader is careful in rehearsals not to overwork the lips of the brass instrumentalists, cornetists, trombonists and horn players.

He never asks the "stringers" if they are tired. Often, after a few hours' work he asks the cornetists if they have had "enough for today." There is a limit to the fatigue that should be inflicted on the lips. If this limit is exceeded, the guying and especially the orbicular muscles will weaken, just as the laryngeal muscles, especially the thyroarytenoidei, do. If this limit is persistently exceeded, permanent muscular disability may ensue. Many a bugler has permanently "lost his lip."

SYMPTOMS

There are three groups of symptoms that are outstanding, namely, (*a*) chronic hoarseness; (*b*) vocal fatigue; (*c*) myasthenia vocalis, loss of tone power; (*d*) dysphonia, or mogiphonia; (*e*) odynophonia, and (*f*) dysphonia spastica.

The hoarseness is similar to that of chronic laryngitis. It is usually worse after a prolonged period of practice or a long performance. Then it is usually accompanied by a subjective sense of vocal fatigue. Usually the voice starts off well but soon weakens. After a long strenuous vocal task it may be weak and husky. In contrast with his previous power of endurance, the patient notices that after a brief period of practice or performance the voice weakens in power of tone production; the more difficult upper notes are increasingly difficult or impossible. This is the chief form of dysphonia, though in some cases the disability is most troublesome in starting to produce any tone whatever, constituting mogiphonia.

Myasthenia laryngis is analogous to writer's cramp in the earlier stage of the latter disease, in which there is a sense of fatigue in the hands with awkwardness and feebleness in the fingers, with such lack of control that the writing becomes increasingly illegible. In myasthenia vocalis the patient complains that the voice seems weak; it does not have its usual power of tone. Imperfect control follows gradually after a time; in rare instances its onset is sudden.

The symptom dysphonia spastica is not uncommon. It resembles the later, or spastic, stage of writer's cramp. The attempt to sing or to speak in public brings on a spasm of the phonatory muscles; ordinary conversation may or may not excite the spasm. Usually the spastic condition is limited to the orbicular group of muscles, though in some cases both the orbicular and the divergent groups are affected. In some cases the spasms are painful, like those of runner's cramps.

Naturally, dysphonia engenders another symptom, namely, loss of confidence in the voice on the part of the patient. This is of especial importance in cases in which the patient previously had confidence in the power to produce tone and pitch at will. This loss of control usually dawns on the patient as the result of embarrassing shortcomings at a

public performance. It is not to be confused with ordinary stage fright or the lack of confidence of the beginner.

Odynophonia is often present, chiefly because of the indirect trauma inflicted by the additional force the patient has applied in the effort to overcome the difficulty. It may mean only muscular strain, but often there is myositis.

DIAGNOSIS

Notwithstanding the objections to the medical use of the word always, it seems justifiable to state that myasthenia laryngis is always mistaken for chronic laryngitis, which may or may not coexist.

A tentative diagnosis can usually be made on the patient's complaint and always on the laryngeal appearances.

In a typical case a vocalist, male or female, who has attained success of great or lesser degree complains of the voice "cracking" or "breaking" and of loss of confidence. It is usually stated, in effect, that after a long period of arduous training the singer had perfect confidence in the voice and could always count on striking the absolute pitch; but that recently there has been failure to strike the note or to hold it after striking it.

Mirror Appearances.—In order to recognize the mirror appearances of myasthenia laryngis it is necessary to be familiar with the appearances of the normal positions and actions imposed on the larynx primarily by the musculature and secondarily by the air current. To become familiar with these appearances it is necessary to make many examinations of the larynges of singers trained to hold a tone. The normal appearances in the untrained may be very confusing.

The thoroughly trained vocalist sets the larynx before the air column is permitted to pass through the glottis. Only in this way is it possible to be sure of striking exactly the right pitch for the tone desired. If any air were permitted to escape before the exact setting, the note would be faulty, and adjusting it to the proper pitch would be an embarrassing technical shortcoming. Moreover, accessory sounds would impair purity of tone. In the untrained any note, no matter how imperfect, may be produced, and the set is haphazard.

The following mechanism is observed in the trained vocalist:

The muscles of the guying group (the cricothyroidei and the cricoarytenoidei postici) are seen to act first, momentarily elongating the cords. In the fraction of a second the muscles of the orbicular group (the arytenoideus, the cricoarytenoidei laterales and the thyroarytenoidei) contract, lessening the glottic diameter, bringing the edges of the cords in contact, thinning the cord and compressing the edges. In another fraction of a second the cords are seen to form a chink under the pressure of the emerging air. The form and position of this chink, as well as the thinness and degree of compression of the cordal edges,

are dependent on the pitch of the note produced, and it is obvious that the set of the thyroarytenoideus muscles must have been established before the air was permitted to emerge. Doubtless the thyroarytenoidei must have been coordinately supported by the lateralis, but this is not obvious.

A good way to get the singer to slow the sequence and render it appreciable by prolonging the interval between the guying and the orbicular action is to request the singer to prepare slowly for striking a note of a certain pitch but not to sound the note until asked. Few singers can do this with the mirror in place until after much practice and great tolerance for the mirror have enabled them to do it. It can be observed that the extent of the guying movement is proportionate to the pitch by comparing the set for notes of an octave interval. It is usually perceptible with an interval of a fifth but not with an interval of a third.

The chief characteristic of the mirror appearances in most cases of myasthenia laryngis is failure to hold the set of the larynx for tone. The muscles of the guying group usually act promptly. The orbicular group follows, sometimes promptly and at other times sluggishly. In either case the perfect set is not held for a long time. The glottis is seen gradually to lose its shape; the edges separate, and the tone loses its clarity and usually drops in pitch. In some cases the tone is suddenly lost, and the chink of the whole membranous glottis becomes elliptic, with flaccid margins, denoting complete failure of the thyroarytenoidei, followed by relaxation of the cricothyroidei.

In many cases the typical appearances just described are not manifest at the first inspection, and, as has been mentioned, they may not appear until the patient has made many phonations with the mirror in place. In still other cases the myasthenic appearances can be found only by having the patient come in after fatiguing practice or performance. In these cases the disability is in an earlier stage, and the patient sometimes gets through a performance fairly well. Examination is usually best made when the voice has "broken," "cracked" or "let down." In all such cases it is important to make and record for comparison a mirror examination at an interval when the voice is at its best. This is usually after a period of vocal rest, but it is well simply to ask the patient to come in when the voice seems most responsive to control.

The typical appearances described may be altered in some cases by spasmodic action of the orbicular group of muscles, but rarely by the guying group. When the patient endeavors to phonate, there is a snapping shut of the glottic chink, quickly followed by relaxation of the glottic margins into a more or less elliptic form. Sometimes this picture is noted before the patient attempts to phonate.

The mucosa may be normal, though usually it shows the vascular engorgement secondary to forceful phonation. Due allowance must be

made for the fact that the mucosa of singers (and of professional voice users as a rule) is more vascular than that of the average person, who does not use the voice excessively. In hucksters, train announcers, evangelists, stump speakers and other habitual abusers of the larynx, myasthenia laryngis is usually accompanied by the hyperplastic laryngitis associated with such gross vocal abuse, including occupational use during attacks of acute infective laryngitis.

In differential diagnosis, diseases of the recurrent laryngeal nerves are to be excluded. Myasthenia gravis may present somewhat the same laryngeal appearances, but the general disease is easily excluded by the neurologist. In cases of occupational compensation claims the laryngologist will be able to detect malingering by the evident lack of best effort at phonation. Of course, all organic lesions, such as tumors in the conus elasticus impairing movement of the lateralis or of the thyroarytenoideus muscle, must be excluded, and the same may be said as to the other muscles concerned in phonation. Myositis, arthritis and disease of the laryngeal cartilages will of course be eliminated by a thorough laryngeal examination in all of its four phases.[1]

PROPHYLAXIS

Prevention of myasthenia laryngis is simple in principle but difficult in practice.

It is essential that both the laryngologist and the patient recognize the fact that, though faulty methods of vocal training are ruinous to the voice, the voice can be forever ruined by excessive singing by any method. The laryngeal muscles must have rest. The rest should be daily and must be absolute. The duration of the rest periods must be prolonged in proportion to both the severity and duration of the vocal work for that particular day.

By rest in this connection I mean absolute silence. The patient must understand that, though strenuous vocal work is most severe on the larynx, talking, humming or even whispering call for work by laryngeal muscles that robs them of the needed rest. Observation will convince any one that whereas the tennis player, the athlete and the prize fighter realize the necessity for rest of the muscular system while in training, most vocalists talk incessantly when not singing.

As has been demonstrated, the deplorable ruin of many voices is attributable largely to striving for higher and still higher pitches; this should be carefully avoided. It would seem better for a young vocalist to be contented with a good, and permanently good, voice rather than to lose the best quality of voice by striving to extend the range beyond safe limits.

Similar difficulties pertain to all professional voice users except as to the struggle for extending the pitch of the voice upward by prolonged and strenuous training.

All actors and public speakers as well as singers are confronted by the feeling of obligation to go through with their engagements, notwithstanding acute infective laryngitis, and they hope that the larynx will stand it, regardless of the advice of the laryngologist. Occupational voice abusers do not foresee the calamity of loss of voice as vocalists do.

The extension of the pitch upward is due to enthusiasm, emotion or even frenzy of exhortation, which takes the form of high-pitched shouting and shrieking. This is often incidental to work before an audience, but many speakers add to the abuse by rehearsal of the frenzied, high-pitched climaxes. Such oratory appeals only to the unthinking masses. The speaker should develop a logical appeal to intellect or quit, if he wishes to avoid myasthenia laryngis from disabled thyroarytenoideus muscles. A range of an octave in middle scale is adequate for emphasis if the logic is good.

Under all lies the fundamental fact that almost all persons who have myasthenia laryngis are incessant conversationalists. If they were to maintain absolute silence when off duty, the disability in many instances could be avoided.

Total abstinence from both smoking tobacco and alcohol is important in prophylaxis.[1] Alcohol as a beverage has been the ruin of many a promising career. These factors concern myasthenia laryngis as well as mucosal laryngitis.

TREATMENT

Nowhere is the adage "prevention is better than cure" more applicable; and it may be added that cure is obtainable only in the earlier stages of the disease.

Prompt and implicit obedience to a rigid regimen is essential. First comes absolute rest of the singing voice for three to six months. Only a limited use of the conversational voice may be permitted, say 500 words a day; this should be only in quiet surroundings, and the voice should be low and of natural pitch. After this preliminary rest period the patient may be allowed to start all over again in vocal training, keeping strictly within the natural range and avoiding all attempts at extension upward or downward. Only after a year or so of this limited training may the patient be allowed to commence extension upward, and this should be only by slow stages. At the first sign of return of the trouble, efforts at extension must be dropped for months.

The patient must be brought to realize that the voice is precious and is not to be squandered in idle conversation. Any day in which there is vocal training or performance calls for absolute conversational silence.

One of the pitfalls in treatment is the supposition that some different system of vocal training or some special exercises will cure damaged thyroarytenoideus muscles. This is a fallacy. No training or special

exercises can be carried out without working the already jaded muscles. It is true that the training that brought on the trouble may have been faulty or even ruinous, but before a better system is undertaken the muscles must be allowed to recover from the damage previously done.

The best advice to give the great singer is to retire before disastrous failure causes lifelong regret. Long rest of the voice may permit a little singing in a small room for the singer's own pleasure and the entertainment of friends, but return to the grand performance will court disaster. I have never known any singer or actress with this condition to regret giving up concert or operatic work even while in the prime of the career.

PROGNOSIS

In a case of advanced involvement in a great singer the prognosis as to the future career is hopeless. If the patient, after a regimen of rest, will be contented with a little humming and an occasional bit of song in a small room, a satisfactory conversational tone may be retained. But the concert and opera are to be regarded as things of the past in such cases.

Public speakers ordinarily may count on a moderate amount of speaking with long intervals of rest. Voice as such is not under criticism so much as what they have to say. To the singer the alternative to perfect tone is utter failure of the musical career.

Train callers and similar abusers of the voice, if the myasthenia is well advanced, rate a total permanent disability for that particular occupation; though they can, with care, retain a good useful voice for relatively silent occupations. In early stages the disability may be controlled by a proper regimen to permit continuance after a long rest period.

CONCLUSIONS

1. Myasthenia laryngis is a morbid entity entirely independent of chronic laryngitis, which may or may not be concurrent. It is a muscular disability as distinguished from a mucosal inflammation.

2. There seems to be a failure on the part of laryngologic writers to recognize muscular asthenia as the fundamental condition in hoarseness and vocal impairment of singers, clergymen, evangelists, public speakers, incessant conversationalists and other abusers of the voice. Most writers consider only chronic mucosal inflammation in such cases.

3. In clinical work, in a large proportion of the cases of chronic hoarseness associated with vocal abuse and supposed to be due to chronic laryngitis, the condition is really a muscular disability, involving most severely the thyroarytenoideus muscles. Failure to recognize this fundamental fact explains the frequent disappointment in the treatment of chronic hoarseness.

4. The larynx, with its controllable supraglottic and infraglottic air column, constitutes an air column instrument closely analogous to the cornet, and a study of this instrument sheds important light on the subject of the laryngeal phonatory mechanism. Careful observation of my lips through the transparent mouthpiece, together with the subjective sensation of the muscular action concerned, have convinced me of the following facts: 1. The action of the lips in setting in vibration the air column of the cornet consists of contraction of the orbicularis oris muscle, resisted by bilateral contraction of the two lateral groups of diverging muscles, one at each end of the mouth. 2. The guying of the angles of the mouth precedes the contraction of the orbicularis. The fixation thus afforded makes a slitlike chink and at the same time enables the orbicularis muscle to firm the edges of the upper and the lower lip into bands that are set in vibration when air is forced between them in their firmly held position. 3. It is not the direct impact of the vibrating lip margins that sets the air column in vibration but rather the siren-like cutting of the air stream into puffs.

5. Every one of these actions has an analogy in laryngeal phonation. Observation with the mirror and palpation of the neck, analyzed in the light of my studies of the phonetic mechanism of the cornet, have convinced me that the laryngeal phonatory mechanism consists in contraction of an orbicular group of muscles preceded and opposed by a guying group of divergent muscles. Unresisted, the orbicular group would cause a more or less circular glottic chink. The prior endwise guying by the divergent group serves as fixation points; the pull against these points results in an elongated chink, and enables the thyroarytenoideus muscles, which constitute the glottic margins, to firm these margins as necessary for the pitch desired for the fundamental note.

6. In developing phonation nature seems simply to have made use of the phylogenetically earliest primary valvular mud-excluding laryngeal function, using the opening and the closing mechanisms in opposition to each other. The firmer the margins, the quicker the recoil; hence the greater the vibratory frequency and the higher the pitch of the fundamental note produced.

7. The studies mentioned here show that myasthenia laryngis is the result of overworked thyroarytenoideus muscles and that this fact is fundamental to diagnosis, prophylaxis and treatment of chronic hoarseness.

8. About 95 per cent of the aspirants for a career in vocal music are compelled to give up because of myasthenia laryngis. The damage is usually done by the training necessary to increase the range upward. It is deplorable that composers write so much for constant instead of occasional use of notes of high pitch.

NYSTAGMOGRAPHY

A METHOD FOR THE GRAPHIC RECORDING OF NYSTAGMUS DURING AND AFTER TURNING AND OF CALORIC NYSTAGMUS

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LOS ANGELES

The graphic recording of nystagmus for clinical purposes has lagged far behind methods used in audiometry. The audiogram was the supplement of the audiometer and gave a more or less uniform method of detailing the results of hearing tests which the use of tuning forks of different types, employed with varied technics, did not afford. That the graphic recording of hearing tests has played no small part in the upsurge of interest in things audiometric is no less true than the fact that the lack of some practical method of recording nystagmus has held in abeyance the progress of clinical neuro-otology. There have been a deplorable vagueness and lack of uniformity in the reporting of vestibular phenomena. Nystagmus is spoken of as rapid or slow, which tells nothing regarding the number of beats per second; or the amplitude may be described as large or small; yet how can it be determined where small ends and large begins?

This vagueness and lack of definite terminology have made difficult the keeping and sending of accurate records. It is evident, then, that any uniform, practical and precise method of recording nystagmus would be a welcome addition to the equipment for vestibular examinations and would stimulate a wider interest in what may well be called the "minority element" of the inner ear.

Many methods have been devised for the graphic recording of nystagmus. The majority are adaptable only to laboratory use. The few that are suitable for use in clinical work are capable of recording only postcaloric nystagmus, for which the patient does not have to be rotated. The technics heretofore used fall into three general classes: (1) the mechanical method, which employs tambours placed against the closed eyelids and in which the movements are transmitted pneumatically to a kymograph by a recording lever;[1] (2) the recording

This study was made possible by a grant from the Otological Research Department of the Good Hope Clinic.

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1. (*a*) Buys, E., and Coppez, H.: Bull. Acad. roy. de méd. de Belgique **24**: 553, 1910. (*b*) Schackwitz, A.: Ztschr. f. Psychol. u. Physiol. d. Sinnesorg. **63**:442, 1913. (*c*) Ohm, J.: Arch. f. Ophth. **120**:235, 1928. (*d*) Grünberg, G. I.: Ztschr. f. Hals-, Nasen- u. Ohrenh. **13**:283, 1926.

of coreoretinal electric potentials set up by ocular movements, a technic using either the string galvanometer [2] or a modification which employs the coupled vacuum tube amplifier for showing resistance capacity,[3] and (3) photographic registration.

The mechanical and galvanic methods have inherent drawbacks. The pressure of the tambours inhibits the amplitude and duration of the nystagmus. Furthermore, with such devices it is difficult to distinguish between the motion of the eyeball and independent waves set up by movements of the eyelids. The use of recording levers in both procedures interferes with the transmission of the more delicate impulses from the ocular movements. Neither is applicable to the recording of nystagmus either during or after turning. The photographic method, while overcoming most of these objections, has not been adaptable to everyday use. Wojatschek [4] fastened a small mirror to the closed eyelid and recorded the movements of a reflected beam on a film. Wiederscheim [5] secured a small metal knob to the cornea and with a moving picture camera recorded the movements of the knob on a film with frames exposed at the same rate as the beats of the nystagmus. Marx and Trendelenberg [6] and later Dohlman [7] photographed nystagmus by attaching reflecting surfaces to the lids or directly to the cornea—methods inapplicable to clinical use. Moreover, the use of the regulation camera taking a set number of frames or exposures a second results, not in a continuous graph but rather in a series of exposures from which a continuous curve would have to be reconstructed.

This objection was eliminated by the Struychen [8] technic, which records continuously on a moving strip of photosensitive paper the reflections from a metal knob attached to the corneal surface. It remained for S. Kuilman [9] to employ a modification of this method to obtain a graphic record of rotary and postrotary nystagmus. His use of rods attached to the anesthetized cornea and of a cumbersome revolving table preclude the employment of the technic for general use.

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2. (*a*) Schott, E.: Deutsches Arch. f. klin. Med. **140**:79, 1922. (*b*) Meyers, I. L.: Electronystagmography: Graphic Study of Action Currents in Nystagmus, Arch. Neurol. & Psychiat. **21**:901 (April) 1929. (*c*) Mowrer, O. H.; Ruch, T. C., and Miller, N. E.: Am. J. Physiol. **114**:423, 1936.

3. (*a*) Perlman, H. B., and Case, T. J.: Laryngoscope **49**:217, 1939. (*b*) Schott.[2a]

4. Wojatschek, W.: Arch. f. Ohrenh. **77**:230, 1908.

5. Wiederscheim, O.: Klin. Monatsbl. f. Augenh. **83**:7, 1929.

6. Marx, E., and Trendelenberg, W.: Ztschr. f. Psychol. u. Physiol. d. Sinnesorg. (pt. 2) **42**:88, 1911.

7. Dohlman, G. F.: Acta oto-laryng., 1925, supp. 5, p. 1.

8. Struychen, in Abderhalden, E.: Handbuch der biologischen Arbeitsmethoden, Berlin, Urban & Schwarzenberg, 1922, pt. 9, no. 2, p. 455.

9. Kuilman, J.: Ztschr. f. Hals-, Nasen- u. Ohrenh. **35**:85, 1933.

The present method is a modification of the photographic technic and entails in part the use of equipment which was designed for an entirely different purpose. The apparatus is known as the ophthalmograph and is made by the American Optical Company. It is a development of research work done in photography of ocular movement by Dr. Raymond Dodge at Wesleyan University. While the original principle is utilized, the apparatus has been adapted in the present study so as to record the movements of induced nystagmus. In theory the method is simple. A beam of light, directed against the eye, gives back from the surface of the cornea what is known as the corneal light reflex, comparable to the light reflex from the tympanic membrane. When the eye moves, this dot of light moves. Consequently, the photographing of this reflection on a continuous film results in a graph of ocular movements, including nystagmus. The term "continuous film" is used to distinguish between the record produced by this camera and that of the conventional moving picture machine, which employs frames or a series of exposures per second.

The camera has two telescopic lenses, one for each eye. The lighting is so arranged that it takes a picture, not of the eyes themselves but only of the light reflex. Head rest and chin support assure a constant distance between eye and lens. There is a reflex finder of ground glass by which one may focus the corneal reflection on the center of the film. The subject wears suitable prism glasses (plus 2.50 spheres combined with 7.5 prism diopters), which obviate the inhibiting factor of accommodation. The eyes are kept fixed on a spot painted on a mirror which is attached to the camera. The mirror serves two purposes simultaneously: keeping the patient's eye fixed and enabling the operator to observe the nystagmus from above. The magazine holds 100 feet of 32 mm. film. By means of a take-up box any portion of exposed film may be removed for development. It may be read in the same manner as a roentgenogram or may be printed on suitably calibrated paper. Since the film travels through the camera at a constant speed of ½ inch (1.27 cm.) per second, it is a simple matter to compute the exact frequency of the nystagmic beats per second as well as the total duration. The lenses being at a fixed distance from the subject's eyes, the amplitude of the curve will be constant. That is to say, there will be no fluctuation in the size of the wave due to variation in the distance between the eye and the camera. If one wishes the exact size of the ocular movement, it may be computed. One millimeter on the film represents approximately 0.04 mm. of movement of the scleral surface.

CALORIC NYSTAGMUS

It was easy to adapt the ophthalmograph to the recording of caloric nystagmus. The ear to be tested was irrigated in the usual manner and the resultant rotary nystagmus photographed. Since the average

reaction with water at 68 F. does not begin until after approximately forty-five seconds, the camera is not started until a suitable interval has elapsed. My first graphs of rotary nystagmus were disappointing. They resulted in straight lines punctuated by dots, or at best, beats of small amplitude. The explanation, of course, was that only the horizontal elements of the rotary movement were being recorded. If this horizontal element was marked, as was not always the case, the tracing showed fairly well defined rhythmic beats. The vertical movement, since it is in the same direction as that of the film, was represented by only a straight line. As the name implies, the true form of this type of nystagmus is a movement of rotation in which the eyeball turns around an axis corresponding to the light cone, which theoretically remains stationary. As a matter of fact, however, there is a small but definite movement of the eye, both horizontally and vertically. During the past few months—too recently to warrant mention except in passing—I have attempted to obtain a more accurate evaluation of rotary nystagmus. When a reversing prism is placed in front of one camera lens, as suggested by Struychen,[8] the reflected light from the corresponding eye is refracted at right angles. In effect, the film before one eye is moving vertically and that before the other horizontally. It is thus possible to obtain simultaneously during a rotary movement the vertical component in one eye and the horizontal in the other. How much additional information this will give will have to await further investigation.

Figure 3, I is a graph obtained after douching of the left ear. The prism was not used, so that only the horizontal or oblique movements are recorded. While neither the rotary form nor the vertical component is reproduced, the graph affords a definite amount of information. From it can be ascertained the time of onset, the frequency and the direction, to an extent the amplitude and if necessary the duration of the nystagmus. The long stroke, which corresponds to the slow component, rises but little above the horizontal axis until just before the end of the phase, at which point it is often notched. At the end of the long stroke, there is an abrupt rise and fall, which represent the horizontal elements of the cycle. One would assume, then, that during the slow phase of the rotary cycle the excursion is largely vertical, while the recovery motion, or quick component, is predominantly horizontal.

NYSTAGMUS DURING AND AFTER TURNING

While it is thus possible to obtain by means of the nystagmograph a fairly satisfactory record of the caloric reaction, this would by no means justify the general use of the instrument. After the experiments just described, an attempt was made to record nystagmus after turning. By the time the subject was turned and the camera wheeled into place and focused, the nystagmus had all but disappeared, and the results were

negligible. The natural sequence was to attach the camera to the revolving chair (fig. 1). Since the power for the camera is furnished by an electric motor, the problem of inducting the current into the moving chair had to be met. This was accomplished by means of contacts revolving around a copper plate surrounding the base of the pedestal (fig. 2). A suitable mounting for the camera was attached to the footboard in order to provide for adjustments up and down, forward and backward.

During the past eighteen months forty odd nystagmographs have been made in the otologic department of the Good Hope Clinic. The majority of these include recordings of nystagmus made during and after turning. From material so scant, it is possible to draw only general inferences. However, certain characteristics of the curves obtained during and after turning appear to be more or less consistent in occurrence. Phenomena are brought under observation which it has not been possible to study in routine tests. Heretofore only the after-effects of stimulation have been considered in the rotation tests. Apart from results of laboratory procedure, knowledge of what goes on during actual turning has been meager. It is known that the nystagmus reverses itself in the after-turning phase. What it has not been possible to study is the behavior of the nystagmus *during* rotation or the various relations of the turning to the after-turning phase.

In the normal person the rotation stimulus has been found to result in a series of ocular movements exhibiting three distinct and fairly consistent aspects. These will be designated as the phases of turning, reversal and after-turning. They are represented on the nystagmogram by differences in grouping and in direction, amplitude, frequency and form of the nystagmic cycles.

The first, or turning, phase resolves itself into two periods (fig. 3, II *A* and *B*). At the beginning of rotation, the nystagmus becomes established practically at once; its amplitude and frequency do not build up gradually. Prolonged rotation affects chiefly the duration of the after-turning nystagmus, not its other characteristics. Beyond the fourth or fifth turn, the form of the nystagmic cycle begins to change (fig. 3, II *B*). It is characterized by a loss of proportion between the slow and the quick component. The frequency remains approximately the same, but the long stroke becomes shorter and the short beat longer until, except for an occasional characteristic cycle, it becomes difficult to differentiate between the two components. This probably indicates that point at which the movement of endolymph catches up with that of the chair. As a result of this observation it has been noted that when five instead of the conventional ten turns are used, nothing is sacrificed as regards amplitude or frequency; the nystagmus after turning is identical except that its duration is reduced by half. Since in a nystagmogram it is possible to study responses at leisure, it is obviously advisable

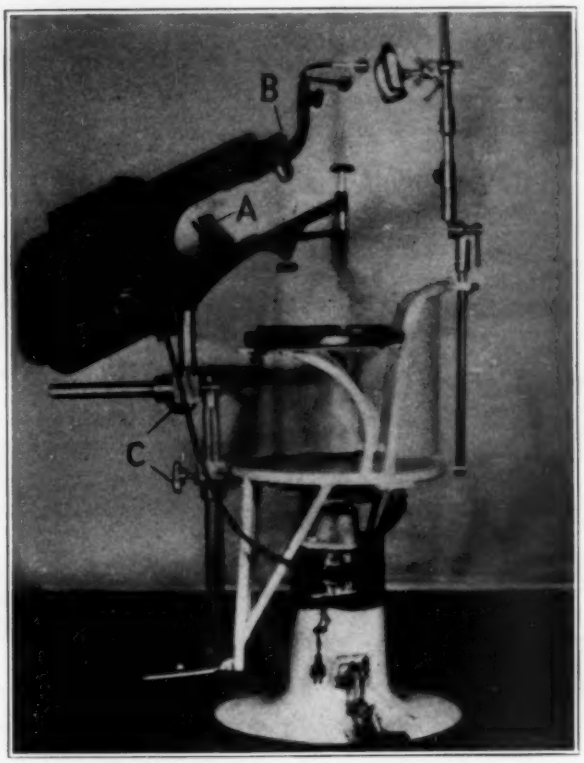

Fig. 1.—Camera for recording nystagmus, mounted on a chair. *A* indicates the mirror, *B* the lenses and *C* the adjusting gears.

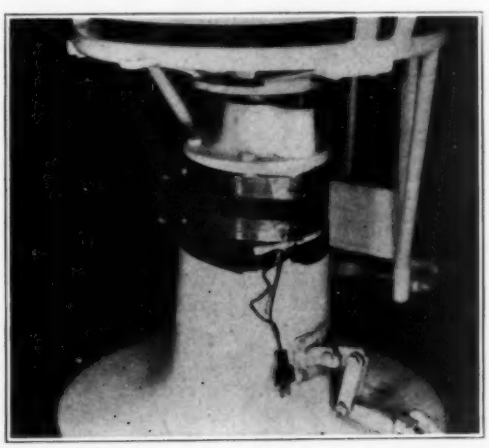

Fig. 2.—Detail of apparatus in figure 2, showing revolving contacts around the base of the chair.

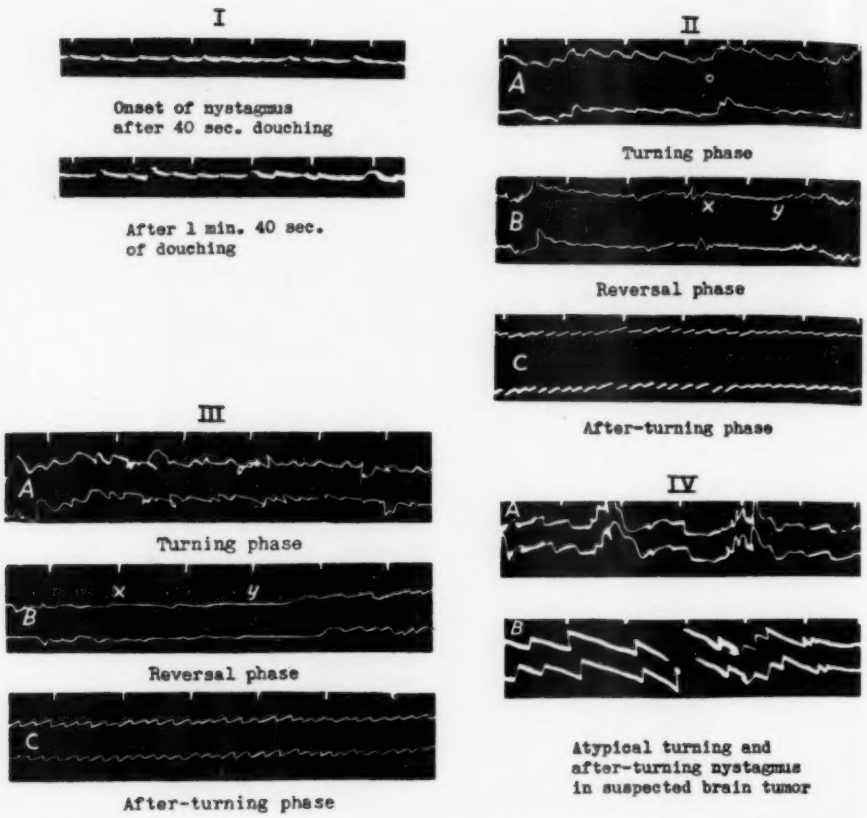

Fig. 3.—Graphic studies of various types of nystagmus. Group I illustrates caloric nystagmus of one eye in response to stimulation of the left ear. *A* shows the onset of nystagmus after forty seconds of douching and *B* the full formed nystagmus (same graph) after sixty seconds of douching. The difference in type of curve as compared with that of nystagmus after turning, shown by II and III, is to be noted.

Group II gives three sections from the same nystagmogram of a normal subject. The rotation was to the right. The dots at the top mark intervals of one second. The right eye is represented by the line above and the left eye by the one below. *A* gives the first three turns, showing immediate onset of nystagmus. The quick component (corresponding to the short stroke) was to the patient's right. *B* gives the tenth turn, ending at *x*, showing loss of proportion between the slow and the quick component. The reversal phase (*x*—*y*) is also shown, followed by the beginning of the after-turning phase. *C*, illustrating nystagmus after turning, demonstrates reversal in the direction of the quick and the slow component.

Group III likewise shows sections from the nystagmogram of a normal subject. The picture is practically the same as in II, except for the well marked reversal phase, *B*, *x*—*y*.

Group IV represents extremely large, slow, irregular nystagmus in a patient thought to have a tumor of the brain. The nystagmus during turning, *A*, and after turning, *B*, should be compared with those shown in II and III.

to rotate the subject only a sufficient number of times to secure the desired result and thus economize both in the comfort of the patient and in the length of the film. If these observations prove correct, it is possible that for the purpose of nystagmography five turns may suffice.

Stopping of the chair marks the beginning of the second, or reversal, phase. This interval varies in length. It may be momentary or last several seconds. It may be sharply defined or emerge gradually from the latter part of the first phase. As may be seen in figure 3, III *B* *x*—*y*, it is represented by a straight line indicating a period during which there is no nystagmus. This apparently represents the phase during which the direction of the flow of the endolymph is undergoing a reversal. The significance of the varying lengths of time during this reversal is not known.

The third, or after-turning, phase begins abruptly at the end of the period of latency (fig. 3, II and III *C*). The nystagmus is of course reversed as compared with the turning phase. It becomes well defined as regards amplitude and frequency by the end of the first second. The beat is more rapid than in the turning phase by a ratio of approximately 2 to 1. There are four or five cycles per second, and the amplitude of these is smaller than occurs during rotation.

CONCLUSION

The foregoing observations have been made on the basis of nystagmograms of presumably normal persons. They are tentative and may be modified by subsequent experience. All manner of variations have been noted in people with abnormal vestibular conditions. Figure 3, IV shows how greatly the type and character of the nystagmic curve may vary; it is the graph of nystagmus after turning, made for a patient thought to have brain tumor.

The scarcity of material forbids any except the most sketchy interpretation, and it should not be inferred that complete vestibular tests can be carried out at present by nystagmography. There are definite limitations. The observation of spontaneous phenomena, past pointing and constitutional symptoms has as much place as ever in the curriculum. Nevertheless, nystagmography, if made available to every one, should fill a definite need. It affords an opportunity to interpret at leisure, observations hitherto made and interpreted in haste. It gives a common yardstick and basis for comparison not possible with present methods.

It may prove to be of practical value in presenting evidence in court in the event of industrial injuries involving the inner ear.

This has been simply the presentation of a technic, a precision method available to every one, for the graphic recording of nystagmus. What the clinical or physiologic implications may be time and further use will have to determine.

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LARYNGOLOGIC ASPECTS OF SPORADIC INFECTIOUS MONONUCLEOSIS

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Infectious mononucleosis is an acute self-limited disease which is so frequently associated with symptoms and signs involving the upper part of the respiratory system that it should be constantly kept in mind by the laryngologist. It is in the hope of promoting closer cooperation between the laryngologist, the hematologist and the serologist that this study of 9 cases is presented.

HISTORICAL DATA

In 1889 Pfeiffer [1] described a condition, characterized by a short febrile course and enlarged tender cervical lymph nodes and occurring in house epidemics, which he called *"Drüsenfieber."* During the following twenty years there were numerous references in the literature to the condition called glandular fever.[2]

In 1896, West [3] reported an epidemic of 96 cases of a febrile disease lasting nine to twenty-seven days and accompanied by enlargement of the cervical lymph nodes. In some instances abdominal tenderness and frequently enlargement of the spleen and liver were noted. Recovery was the rule.

The first cases in which the blood was studied were reported in 1918 by Deussing.[4] The patients were boys who presented diphtheria-like sore throat, fever, enlarged glands, large spleens and leukocytosis, the white blood cell count ranging from 11,000 to 19,400 per cubic millimeter, with 52 per cent to 87 per cent mononuclear cells. In 1920, Sprunt and Evans [5] described 6 cases of a febrile disease with moderate prostration and moderate general glandular enlargement, with a total leukocyte count which was at first normal but later showed a moderate

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Read at the Sixty-Second Annual Congress of the American Laryngological Association, Rye, N. Y., May 28, 1940.

1. Pfeiffer, E.: Drüsenfieber, Jahrb. f. Kinderh. **29**:257, 1889.

2. Longcope, W. T.: Infectious Mononucleosis, with Report of Ten Cases, Am. J. M. Sc. **164**:781, 1923.

3. West, J. P., cited by Longcope.[2]

4. Deussing, R.: Ueber diphtherieähnliche Anginen mit lymphatischen Reaktion, Deutsche med. Wchnschr. **44**:513 and 542, 1918.

5. Sprunt, T. P., and Evans, F. A.: Mononuclear Leukocytosis in Reaction to Acute Infections, Bull. Johns Hopkins Hosp. **31**:410, 1920.

increase and in which the differential blood count showed a slight increase in the large mononuclear transitional cells and the presence of many pathologic lymphoid forms. To this condition they gave the name "infectious mononucleosis." These were sporadic cases, but in all probability the disease entity was identical with the glandular fever just described, which occurred in epidemics.

ETIOLOGIC FACTORS

The cause of the condition is obscure. It is due to an unknown specific agent, which, because of the frequent early involvement of the throat and of the cervical lymph glands, probably gains entrance through the pharynx or the tonsils, a view which is shared by Longcope [2] and by Sprunt and Evans.[5] Vincent's organisms are occasionally found, and Blaedorn [6] and Houghton [7] have expressed an inclination to regard the disease as a form of Vincent's angina. In 3 of my cases spirilla and fusiform bacilli were recovered. In 3 other cases Streptococcus viridans was the predominant organism in the throat.

In 1926, Murray, Webb and Swann [8] found that the Bacterium monocytogenes was the cause of a disease in rabbits characterized by pronounced monocytosis. In 1929, Nyfeldt [9] isolated from the blood an organism which he called Bacterium monocytogenes hominis, with which he produced the typical blood picture in rabbits, and in 1938 Schmidt and Nyfeldt [10] recovered from the spinal fluid of 5 patients with infectious mononucleosis a pure culture of Listerella. It is possible, of course, that the cause is a virus, but whatever it is it certainly has a stimulating effect on the lymphocytic and reticuloendothelial systems and a depressing effect on the granulocytic system.

It has been suggested that infectious mononucleosis may be due to a peculiar tissue response to the ordinary pyogenic infections, but Sprunt and Evans [5] have shown that after recovery from an attack of infectious mononucleosis a patient may exhibit the usual leukocytic response to a pyogenic infection.

Infectious mononucleosis is a disease of childhood and adolescence. While no age is immune, it is rare to encounter the condition after the age of 40. It occurs in epidemic or sporadic form. After adolescence it becomes more and more sporadic. According to Lyght,[11] this may be due to the following factors: (1) the greater disposition of children toward diseases involving the lymphatic system; (2) nonrecognition of

6. Blaedorn, cited by Longcope.[2]
7. Houghton, cited by Longcope.[2]
8. Murray, Webb and Swann, cited by McKinlay.[12]
9. Nyfeldt, cited by McKinlay.[12]
10. Schmidt, V., and Nyfeldt, A.: Ueber Mononucleosis infectiosa und Meningoencephalitis, Acta oto-laryng. **26**:680, 1938.
11. Lyght, C. E.: Infectious Mononucleosis, Journal-Lancet **58**:91, 1938.

cases of mild involvement in adults for want of blood studies, and (3) the possible development of immunity as age increases.

SYMPTOMS AND SIGNS

The symptoms of infectious mononucleosis are varied. Tidy [12] recognized three main types, which he designated as (1) glandular, (2) anginose and (3) febrile. This classification is, however, a very loose one, as most of the patients are febrile, and in a large majority of the sporadic cases either the condition begins with angina or the angina develops during the course of the disease. In a group of 100 consecutive patients treated at the student infirmary of the University of Wisconsin by Lyght,[11] sore throat was encountered in 46 instances as an initial symptom, and an acutely inflamed pharynx was seen in 75 cases. Among 50 cases, McKinlay [13] found angina or infection of the upper part of the respiratory tract present at onset in 54 per cent and stated that patients without angina early frequently had it later, so that 78 per cent of his patients showed some signs of infection of the throat. Four of my own patients had angina at the onset, and, of the remainder, 3 had angina later.

The most constant laryngologic finding is infection of the pharynx. Localized swelling may take place, and 3 of the 5 patients in the cases reported by Schmidt and Nyfeldt [10] were brought into their clinic with a diagnosis of peritonsillar abscess. This may have been due to the fact that all the lymphoid structures of Waldeyer's ring become hypertrophied to a marked degree, and in these cases the mistaken diagnosis may have been due to hypertrophy of the lymphoid tissue of the pharyngeal bands. In many cases a membrane develops, which may be restricted to individual locations but may also involve the entire pharynx. This membrane may cause the disease to be confused with the membranous conditions, such as diphtheria, Vincent's angina and acute membranous streptococcic sore throat. In cases 4, 6 and 9 there was such a membrane.

The process may not stop with injection of the mucous membrane, hypertrophy of the lymphoid tissue and membrane formation. It may at times go on to actual ulceration. In case 3 the entire pharynx was injected; the uvula was edematous and swollen, and there was an ulcerated area in the right tonsillar fossa. In case 5 the entire surface of the pharynx, both tonsillar fossae and the lingual tonsillar area were covered by inflamed, hypertrophied lymph follicles, each of which was

12. Tidy, cited by Tice, F.: Practice of Medicine, Hagerstown, Md., W. F. Prior, Inc., 1938, vol. 6, p. 840.

13. McKinlay, C. A.: Infectious Mononucleosis: Clinical Aspects, J. A. M. A. **105**:761 (Sept. 7) 1935.

tipped by a small white discrete ulcer. This was associated with hoarseness and marked dysphagia. In case 7 there was an ulcer involving the tip of the epiglottis and its lingual surface and associated with considerable dysphagia. In case 9 the tip of the uvula was ulcerated. Marshall [14] reported a case in which the mucous membranes were so swollen as to make respiration difficult. Blum [15] stated that symptoms referable to the throat are usually present. While they may be slight and insignificant or may even appear late in the course of the disease, they may be very severe and simulate diphtheria.

When the disease is not ushered in with a sore throat, the symptoms of onset are frequently those of influenza or an acute cold in the head, with malaise, headache, aching joints, anorexia and low temperature, as in cases 4, 8 and 9. These are conditions which Tidy [12] designated as febrile. In a few of the sporadic cases the initial symptom is adenopathy, as in cases 6 and 7.

The most constant clinical finding is adenopathy, which begins and reaches its maximum development in the cervical triangles. It is often asymmetric, and as a rule the posterior cervical glands are more constantly involved than are those of the anterior triangle. These enlarged glands never suppurate, but the glandular enlargement may persist for a long time after subsidence of the acute symptoms. Downey and Stasney [16] studied lymph nodes taken for biopsy and found hyperplasia of both lymphocytes and reticulum. While the adenopathy is primary and most marked in the cervical lymph nodes, all the lymphoid tissue of the body may become involved.

The fever is not characteristic. It is of a septic type and may show a spiked curve suggesting invasion of the blood stream. The temperature rarely rises above 103 F. Fever usually persists for ten days to two weeks, falling by lysis. In a few cases the patient may be afebrile (5 per cent in Lyght's [11] series). Lyght made the observation that the total white blood cell count bears a direct relation to the height of the fever.

Abdominal symptoms are common in cases of infectious mononucleosis. In cases 2 and 9 there was abdominal tenderness. In cases 6 and 9 the liver was enlarged and palpable below the costal margin, and in case 4 the spleen was palpable. Sturgis [17] pointed out that about 15 per cent of all patients with infectious mononucleosis have abdominal pain, which may at times be so severe as to lead to a laparotomy.

14. Marshall, E. A.: Infectious Mononucleosis, Am. J. Clin. Path. **9**:298, 1939.

15. Blum, L. L.: Infectious Mononucleosis, J. Indiana M. A. **31**:296, 1938.

16. Downey, H., and Stasney, J.: Infectious Mononucleosis: Hematological Studies, J. A. M. A. **105**:764 (Sept. 7) 1935.

17. Sturgis, C. C.: Certain Diseases Associated with Changes in the Circulating Leukocytes, J. Iowa M. Soc. **29**:1, 1939.

Beliveau and Russell [18] and Davidsohn [19] have reported cases of such involvement. Just what these abdominal symptoms are due to is unknown, but it may well be that the abdominal tenderness is caused by enlarged, tender mesenteric lymph glands.

Very interesting are the cases in which there are symptoms indicating involvement of the central nervous system. Eleven such cases have been reported by Hecht-Johansen,[20] Epstein and Dameshek,[21] Epstein,[22] Schmidt and Nyfeldt,[10] Sucher and Schwartz,[23] Gsell,[24] Davidsohn [19] and Marshall.[14] In these cases there were various symptoms of intracranial involvement, such as headache, unconsciousness, convulsions, photophobia, paralysis of the cranial nerves, rigidity of the neck, positive Kernig reactions and spinal fluid with an increased lymphocyte count. The original diagnosis was usually meningitis or meningoencephalitis, and the diagnosis of infectious mononucleosis in most cases was established by the clinical course, the characteristic blood picture and the positive heterophil antibody reaction.

DIAGNOSIS

The diagnosis of acute mononucleosis of the sporadic type can usually be made with certainty at some time during the course of the disease. One observes an acute self-limited condition in an adolescent or a young adult, usually febrile, with either initial or late pharyngeal manifestations, glandular enlargement, a characteristic blood picture and a positive heterophil antibody reaction. The diagnosis is often not made at the onset, because the initial symptoms are varied; the pharyngeal manifestations and glandular hypertrophy may appear late; examination of the blood frequently is not made early in the disease and, if made at this time, often reveals no abnormality, and there is no particular reason to make a heterophil agglutination test at this stage.

Early in the disease the blood picture may be misleading. The leukocyte count may be normal or even subnormal. Later the count rises, but never to enormous heights. Counts as high as 40,000 cells per cubic millimeter have been reported, but as a rule the total count remains below 25,000. In case 1 the highest count reached was 39,600 per cubic

18. Beliveau, R. A., and Russell, B. W.: Infectious Mononucleosis: Report of a Case Presenting Symptoms of Acute Appendicitis, Maine M. J. **29**:167, 1938.

19. Davidsohn, I.: Serological Diagnosis of Infectious Mononucleosis, J. A. M. A. **108**:289 (Jan. 23) 1937.

20. Hecht-Johansen, cited by Schmidt and Nyfeldt.[10]

21. Epstein, S. H., and Dameshek, W.: Involvement of the Central Nervous System in a Case of Glandular Fever, New England J. Med. **205**:1238, 1931.

22. Epstein, cited by Schmidt and Nyfeldt.[10]

23. Sucher and Schwartz, cited by Schmidt and Nyfeldt.[10]

24. Gsell, cited by Schmidt and Nyfeldt.[10]

millimeter, and in case 9, 29,100. In the remainder the total counts ranged between 5,400 and 23,700 per cubic millimeter. There is never any alteration in the elements of the erythropoietic system, the hemoglobin, the red blood cells and the platelets. The differential blood count may be and often is perfectly normal at the onset, but as the disease progresses there takes place a relative lymphocytosis, which later becomes absolute. In case 4, in which the total white blood cell count was 23,000 per cubic millimeter, the neutrophilic cells dropped to 13 per cent and the lymphocytes rose to 87 per cent. When this granulocytic depression occurs in a case in which there is a normal or a subnormal total white cell count it may readily lead to a mistaken diagnosis of agranulocytosis. In 5 of Lyght's [11] 100 cases the granulocytes fell below 10 per cent.

According to Downey and Stasney,[16] the lymphocytosis which follows the initial neutrophilic leukocytosis is usually characterized by the presence of large, atypical basophilic lymphocytes. The abnormal morphologic character of these lymphocytes shows that the condition is not ordinary lymphocytosis as seen in cases of pertussis. Not only is there an increase of the large, abnormal lymphocytes, but in most of the cases there is at some time during the disease an increase in the number of cells usually classified as monocytes.

Although it is probably true that the diagnosis can be established in most of the sporadic cases of infectious mononucleosis by the more or less characteristic blood picture, as Lyght [11] contended, there is available, in the heterophilic antibody reaction, a still more certain diagnostic measure. In 1929, Davidsohn [25] found that the blood of persons suffering from horse serum sickness contained agglutinins for sheep red blood corpuscles in high dilutions. He also found that these agglutinins were present in the blood of 4.2 per cent of 450 persons who had had serum sickness, but in very low titer. In 1932, Paull and Bunnell [26] found these same heterophil antibodies present in the blood of 4 patients with infectious mononucleosis, in much higher dilutions than was the case with sufferers from serum sickness. This heterophil antibody reaction has been confirmed by numerous observers and constitutes a very important step in the diagnosis of infectious mononucleosis if the reaction is positive in high dilutions and if the patient has not previously had serum sickness. In 1937, Davidsohn [19] found that if he treated the serum in a case of infectious mononucleosis with beef red cells or beef heart tissue all the agglutinins for sheep red cells would be removed, and if he treated the serum with guinea pig kidney emulsion he could remove only 50 to 75 per cent of these agglutinins. He, therefore,

25. Davidsohn, I.: Heterophile Antibodies in Serum Sickness, J. Immunol. **16:** 259, 1929.

26. Paull, J. R., and Bunnell, W. W.: The Presence of Heterophile Antibodies in Infectious Mononucleosis, Am. J. M. Sc. **183:**90, 1932.

established the following postulate: "The removal of sheep agglutinins with beef erythrocytes and the failure of guinea-pig kidney to remove them completely establishes the diagnosis of infectious mononucleosis, while complete removal of the agglutinins with guinea-pig kidney excludes infectious mononucleosis."

The differential diagnosis of infectious mononucleosis may present difficulties. Of peculiar interest to the laryngologist is the differentiation of this condition from the other membranous and ulcerative lesions affecting the pharynx, such as diphtheria, Vincent's angina, streptococcic sore throat, agranulocytosis, syphilis and tuberculosis. These can be excluded by the bacteriologic picture, the characteristic blood picture, the heterophil antibody reaction and the benign course. The spiked temperature curve associated with chills may suggest invasion of the blood stream, but this can be excluded by the sterile blood culture, the absence of malarial plasmodia in the blood and the absence of positive agglutination reactions for Malta fever, typhoid and paratyphoid. The blood picture may at times suggest lymphocytic leukemia, but the characteristically benign course of infectious mononucleosis soon rules this out. Acute surgical conditions of the abdomen are soon ruled out by the absence of any sustained neutrophilic response.

Since the advent of sulfanilamide a word of caution is in order. Not infrequently an initial diagnosis of acute streptococcic sore throat is made, as occurred in case 3 of my series. It is known that infectious mononucleosis depresses the granulocytic system and that in some instances administration of sulfanilamide has the same effect. If, then, one administers sulfanilamide to a patient with infectious mononucleosis one may so intensify this depressant action that the bone marrow may not be able to recover its normal function.

There are conditions which present all the clinical features of infectious mononucleosis and which are indistinguishable from this condition but in which the heterophil antibody reaction is negative, and for these conditions Davidsohn proposed the name of lymphocytic angina.

REPORT OF CASES

CASE 1.—T. C. S., a man aged 31, a patient of Dr. A. F. Tessier, was admitted to the Columbia Hospital Aug. 30 and discharged Sept. 16, 1939.

Onset.—About August 23 the patient had a sore throat, a cold in the head, pain in the chest and headache. The temperature at that time was about 103 to 104 F. An initial diagnosis of influenza was made. There were enlarged and painful cervical glands, and the neck was stiff.

The past history and family history were not significant.

Physical Examination.—The patient was well developed. The temperature on admission was 100.5 F. The nose was normal. The throat was injected. He complained of a sore throat. The heart, lungs and abdomen were normal. The anterior and posterior cervical glands were enlarged.

Course.—The temperature fell to normal by lysis on the sixth day in the hospital.

Laboratory Work.—The red blood cell count was 5,600,000 and 5,700,000 per cubic millimeter on two occasions. The leukocyte count rose to 39,600 per cubic millimeter; there were only 15 per cent neutrophils and 83 per cent lymphocytes. There were many large and hypertrophied lymphocytes.

The heterophil antibody test gave a 3 plus reaction in dilutions 1:4 to 1:16; a 2 plus reaction in dilutions 1:32 to 1:64, and a slightly positive reaction in dilutions 1:128 and 1:256. The reaction was negative in a dilution of 1:512.

Smears from the throat showed mixed organisms, Str. viridans predominating.

Case 2.—J. Z., a white woman aged 20, was seen for the first time by Dr. Robert Hiller on May 1, 1939. She had been ill for one week. Her temperature was 100 F. On that day the only significant finding was tenderness in both lower quadrants of the abdomen and over the region of the right kidney. On May 3 there was tenderness in the left ovarian region. The posterior cervical and inguinal glands were enlarged. The pharynx was injected. The blood count was as follows: hemoglobin, 14 Gm., or 84 per cent; red blood cells, 4,920,000, and white blood cells, 7,000, per cubic millimeter; segmented neutrophils, 20 per cent; unsegmented neutrophils, 4 per cent; lymphocytes, 72 per cent (18 per cent of which were hypertrophied); monocytes, 4 per cent, and slight poikilocytosis.

On May 5 the heterophil agglutination reactions were: dilutions 1:4 to 1:32, 3 plus; dilutions 1:64 to 1:128, 2 plus; dilution 1:256, 1 plus; dilution 1:512, faint (trace); dilution 1:1,024, negative.

The glandular swellings had subsided by May 15, but the patient continued to have a low fever for one month after onset and required about two months to recover her strength.

Case 3.—P. V., a man aged 26, a hospital intern, on July 17, 1938, had a sore throat. On the following day his temperature rose to 100.8 F. By this time the sore throat had become worse and was associated with dysphagia and dysarthria. The uvula was swollen and edematous; the pharynx was reddened, and there was an ulcerated area in the right tonsillar fossa. The submaxillary lymph nodes on both sides were swollen and tender. A tentative diagnosis of streptococcic sore throat was made. Three months before the acute onset he had had bleeding gums, from which Vincent's organisms had been recovered. This condition had recurred several times up to the acute onset of the present illness. On admission to the hospital the throat was markedly reddened and the uvula inflamed and edematous, and both tonsillar fossae had yellowish white patchy exudates on them. Smears from these areas yielded Vincent's organism. There was only slight cervical adenopathy.

Three blood counts were made and showed no aberration in the concentration of hemoglobin or erythrocytes; the white cells ranged from 8,600 to 13,700 per cubic millimeter; the mononuclear cells ranged from 64 to 70 per cent, and the heterophil agglutination reaction was positive in dilutions up to 1:64. At no time was there any generalized adenopathy. After discharge from the hospital the sore throat continued for about one week.

Case 4.—H. B. S., a white man aged 25, became acutely ill on March 12, 1937, with symptoms of influenza, aching joints, a slightly sore throat and a low fever. There were no abnormalities of the chest. About the fourth day the throat was markedly inflamed and sore. He was hospitalized on the seventh day, at which

time his temperature was 100.2 F. The temperature rose to 103 F. on the sixth day in the hospital.

Physical examination revealed a very red throat covered with a gray exudate. There was generalized adenopathy, and the spleen was palpable. The chest was clear. The throat was so sore that even talking irritated it.

Under symptomatic treatment the condition gradually improved, although the patient was confined to bed at home for two weeks after his release from the hospital (March 25). Four weeks after the onset the spleen was still palpable.

Five blood counts showed no abnormality in the erythropoietic system. The total white cell count ranged from 11,000 to 23,100 per cubic millimeter of blood. On March 24, with a total leukocyte count of 23,000 per cubic millimeter, the neutrophils were only 13 per cent, and the lymphocytes rose to 87 per cent. The agglutination tests for Malta fever, typhoid and paratyphoid all gave negative results. The heterophil agglutination reaction was positive in dilutions up to 1 : 512.

CASE 5.—A. S., a man aged 20, a student at Dartmouth, was admitted to the University Clinic at Dartmouth on June 11, 1939, with the history of a slightly sore throat and swelling in the submaxillary region for the previous five days. The

Blood Picture

	June 28	June 29	July 20	August 22
Hemoglobin, per cent	84.4	.....	.....	.....
Red blood cells, per cu. mm.	4,240,000	.....	.....	.....
White blood cells, per cu. mm.	13,300	9,900	10,800	7,800
Per Cent Neutrophils:				
Segmented	58.5	41	53	56
Unsegmented	16.5	5	..	2
Per Cent Lymphocytes:				
Small	23.5	48	40	38
Large	....	5	4	..
Monocytes	1.5	3	2	4
Eosinophils	....	1	..	..
Basophils	....	..	1	..

complaints on admission were some headache, dizziness and slight photophobia. The pharynx was injected. There was a large, tender gland at the angle of the jaw on the right side, and moderate enlargement of the other cervical glands on the right side was noted. The temperature ranged from 101 to 103.5 F. for three days and returned to normal on the sixth day. One complete blood count was made, and five daily white cell counts were made. The hemoglobin and red cells were within normal limits. The leukocytes ranged from 5,400 to 10,000 per cubic millimeter of blood. The neutrophils ranged from 45 per cent to 73 per cent; the lymphocytes, from 10 per cent to 48 per cent; in one count the large monocytes were 15 per cent and in another 14 per cent. Culture of material from the throat showed a variety of organisms, with Str. viridans predominating.

The patient returned to his home in Milwaukee, where I saw him on June 28. At this time he complained of intensely sore throat, some hoarseness and marked dysphagia. His temperature was 102 F. The entire pharynx, including the tonsillar fossae (the tonsils had been removed), the posterior pharyngeal wall, the pharyngeal bands and the lingual tonsils, showed markedly hypertrophied and injected lymphoid tissue, and each lymphoid island was tipped by a small discrete ulcer. A smear of material from the throat showed many mixed organisms, including the organisms of Vincent's angina and diphtheroids. The results of examinations of the blood are given in the accompanying table.

On June 30 the heterophil agglutination reaction was 3 plus in dilutions 1:4 to 1:64; 2 plus in dilutions 1:64 to 1:128; plus-minus in the dilution 1:256, and negative in dilutions 1:512 to 1:1,024. The patient made a complete recovery in about two weeks.

CASE 6.—M. M., a white girl aged 19, was admitted to the hospital on June 6, 1931.

Onset—Three to four weeks before admission, painless lumps appeared in the right upper cervical region, at which time the patient had no fever and no constitutional symptoms. Two weeks later she began to feel drowsy and had general malaise but no specific complaints. These general symptoms slowly increased in severity until eight days before admission, when she first noticed a sore throat, which gradually became worse. This was associated with poor appetite, nausea and vomiting.

Examination.—The patient was well nourished but appeared toxic. The skin and scleras had a slightly yellowish tint. No petechiae were present. The nose was normal. The pharynx and both tonsils were dark, beefy red and covered with a dirty membrane. The rest of the mucous membranes were slightly jaundiced. There were enlargement and tenderness of the submaxillary lymph glands, more marked on the right side. The liver was palpable below the costal margin and was tender. The spleen could not be felt. There was no enlargement of the axillary or of the inguinal glands. Gradual improvement took place, and she was discharged from the hospital on June 13. Her temperature ranged from 102.6 F. on admission to 103 F. and fell by lysis on the fourth day in the hospital.

Numerous blood counts showed no particular involvement of the hemoglobin, red cells or platelets; the leukocyte count ranged from 7,150 to 12,900 per cubic millimeter of blood; the neutrophilic granulocytes were depressed, falling as low as 19 per cent; the lymphocytes were 65 per cent on admission and the monocytes rose to 51 per cent two days after admission.

Cultures of material from the throat showed gram-positive cocci in chains, gram-positive and gram-negative cocci in pairs and occasional spirilla and fusiform bacilli. The sedimentation rate was very rapid. (In this case the clinical course was that of infectious mononucleosis, but the condition occurred before discovery of the heterophil antibody reaction.)

CASE 7.—B. J. G., a white girl aged 19 (a patient of Dr. T. L. Tolan), was admitted to Columbia Hospital on July 16, 1931.

Onset.—About ten days before admission she first noticed a nodule on the left side of the neck. The neck became stiff. Three days before admission she complained of severely sore throat and marked prostration.

Past History.—She had had measles and pertussis in childhood, malnutrition and enlarged cervical glands at the age of 12 and frequent colds and epistaxis early in life.

Physical Examination.—The tonsils had been removed. The posterior pharyngeal wall was injected. At the tip of the epiglottis and extending onto its lingual surface was an ulceration the size of a dime, covered with a dirty brown membrane. Dysphagia was present. There were large, tender nodes in the anterior cervical chains, axilla and groin.

Course.—There was gradual improvement, and she was discharged from the hospital on July 25. Her temperature was 101 F. on admission; it rose to 103.4 F., and it returned to normal on the fifth day in the hospital.

The erythropoietic system showed no abnormalities in six examinations of the blood. The leukocyte count ranged from 11,000 to 23,700 per cubic millimeter of blood. The neutrophils ranged from 15.5 per cent to 38.5 per cent, showing a granulocytic depression. The lymphocytes ranged from 35.5 per cent to 56 per cent and the monocytes from 16 per cent to 48.5 per cent. Cultures of material from the throat showed gram-positive cocci, pneumococci and Str. viridans. (This was in all probability a case of infectious mononucleosis, but the diagnosis was not confirmed by the heterophil antibody test.)

Case 8.—R. M., a youth aged 18, was admitted to the Milwaukee County Hospital on March 18, 1939, with the history of an attack of "flu" two weeks before. Several days before admission he had an acute onset of illness, with chills, fever and malaise. There was some pain in the lumbar region. His past history was irrelevant except for measles and scarlet fever at the age of 11.

On admission his appearance was toxic. There was no adenopathy. The lungs and heart were normal. The liver was palpable below the costal margin, but the spleen was not. Agglutination tests for typhoid, paratyphoid, undulant fever and tularemia gave negative results. Cultures of the blood were sterile. Several blood counts showed no depression of the hemoglobin or erythrocytes; the white blood cells ranged from 14,450 to 18,300 per cubic millimeter; there was a marked depression of the granulocytes, and the mononuclear cells (lymphocytes and monocytes) ranged from 79 per cent to 88 per cent. The heterophil agglutination reaction was positive in dilution of 1:4 to 1:1,024. He was discharged on March 28.

He was seen on April 2 by his private physician on account of a recurrence of his symptoms, and on April 12 he again entered the hospital, with a temperature of 104 F., which subsided to normal on the sixth hospital day. On April 13 he had chills.

Physical examination revealed a slight serous discharge from the nose, no gingivitis, slight injection of the pharynx and small palpable cervical nodes, which were not tender. Both the liver and the spleen were palpable. The blood culture was sterile. Agglutination tests for typhoid, paratyphoid and Bacillus melitensis gave negative results. Examination of the blood on April 13 showed: hemoglobin, 91 per cent; red blood cells, 4,480,000, and white blood cells, 16,250, per cubic millimeter; segmented neutrophils, 41 per cent; stab cells, 41 per cent; lymphocytes, 12 per cent, and monocytes, 6 per cent. The Wassermann reaction was negative.

Case 9.—E. M., a white man aged 37, was seen by Dr. T. F. Tolan on Oct. 17, 1935. An attack of hay fever had begun one month previously. One week later the patient had what he termed a severe head cold with malaise. On October 17 he had fever and a severely sore throat, and the cervical glands on the left were enlarged. His temperature was 103 F. He was nauseated; he vomited and complained of pain in the upper left abdominal quadrant. His skin became yellow at this time, and when he was admitted to the hospital, on October 23, he was considerably jaundiced.

On admission both tonsils were swollen. All the mucous membranes of the throat were inflamed. A thin, grayish white membrane extended over the palate, tonsils and pharynx. The end of the uvula was ulcerated. There were enlarged, tender cervical glands on both sides of the neck, more noticeable on the left. On October 26, a discrete punctate rash appeared over the face and trunk. It was thought that this was due to some quinine medication. The liver was palpable below the costal margin, but the spleen was not palpable.

On October 26 the liver was still palpable. The throat was improved, although a large ulcerated area covered with membrane was still present at the lower pole of the left tonsil. His condition gradually improved, so that on October 29 the rash was disappearing, and the temperature remained below 100 all day. The temperature, which was 100.6 F. on admission, ranged up and down in a septic curve, reaching 104 F. on the fourth day and returned to normal on the seventh day in the hospital. Eleven blood counts were made during the period of hospitalization. The hemoglobin content ranged from 75 per cent to 81 per cent; the red cells, from 3,720,000 per cubic millimeter on admission to 4,360,000; the white cells, from 8,400 to 29,100 and the lymphocytes, from 41 per cent to 64 per cent. The platelet count was always normal.

Pharyngeal swabs and cultures revealed a mixed flora, with Str. viridans, staphylococci and a gram-negative coccus predominating. The heterophil agglutination reaction was 3 plus in dilutions 1 : 4 to 1 : 32; 2 plus in the dilution 1 : 64; 1 plus in the dilution 1 : 128, and negative in the dilution 1 : 512.

COMMENT

Infectious mononucleosis may recur after an apparent complete convalescence, as in cases 5 and 8, and at times convalescence is very slow and protracted, as in case 8. The mononucleosis may persist for many weeks after the total white cell count has returned to normal. The glandular enlargement may not subside for many months. Davidsohn [19] has shown that the heterophil antibodies are present in the blood from fifty to two hundred and ninety-six days after subsidence of the clinical signs.

SUMMARY

Repeated studies of the blood should be made in every case of a pharyngeal lesion the diagnosis of which is in doubt. Infectious mononucleosis is an acute, self-limited disease occurring in epidemic or sporadic form in children or young adults; it is characterized by pharyngeal manifestations, fever, glandular enlargement, a characteristic blood picture and an antibody response to a heterophil antigen. Laryngologists must keep this condition in mind when investigating any acute, obscure lesion of the throat.

CANCER OF THE LARYNX

AN ANALYSIS OF TWO HUNDRED AND FIFTY OPERATIVE CASES

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Laryngologists are unanimous in their opinion that early diagnosis and complete removal are essential in the successful surgical treatment of cancer.[1] In order to assure oneself that the measures employed in treatment fulfil the latter requirement it is necessary to study one's cases from the standpoint of end results. This report is based on an experience with 250 cases of cancer of the larynx treated by laryngofissure or laryngectomy. Certain general information will be considered, and statistical data bearing on postoperative mortality, local recurrence, metastasis and surgical procedures will be discussed.

INCIDENCE

It is estimated that about 4 per cent of all malignant tumors occur in the larynx. This information is based almost entirely on actuarial data and death certificates, since cancer is a reportable disease in but few localities. Cases of successful treatment therefore are not included in figures indicating the incidence of cancer. On the basis of fatalities in this series of 250 cases, records in the bureau of vital statistics include but 61 patients, or approximately one fourth of the total number, since death in these cases resulted directly or indirectly from cancer of the larynx. The remaining 189 cases, or 75 per cent of the total number, in which the patients are still alive and are free from cancer or have died from causes unrelated to cancer, will not appear in vital statistical records

Read at the Forty-Sixth Annual Meeting of the American Laryngological, Rhinological and Otological Society, Inc., New York, June 7, 1940.

1. Clerf, L. H., and Crawford, B. L.: Carcinoma of the Larynx: Clinical and Pathological Aspects, Arch. Otolaryng. **16**:676 (Nov.) 1932. Clerf, L. H.: Carcinoma of the Larynx: An Analysis of Fifty-Eight Cases with Treatment by Laryngofissure, ibid. **19**:653 (June) 1934; Subglottic Carcinoma of the Larynx, Pennsylvania M. J. **42**:527 (Feb.) 1939. New, G. B., and Fletcher, E.: Selection of Treatment for Carcinoma of the Larynx, J. A. M. A. **99**:1754 (Nov. 19) 1932. Jackson, C., and Jackson, C. L.: Cancer of the Larynx, Philadelphia, W. B. Saunders Company, 1939. Orton, H. B.: Cancer of the Larynx: Immediate and Ultimate Results of Operation in One Hundred and Two Cases, Arch. Otolaryng. **28**:153 (Aug.) 1938. Thomson, St. C.: Subglottic Cancer of the Larynx, J. Laryng. & Otol. **52**:803 (Dec.) 1937.

as cases of cancer. It is obvious that any attempt to arrive at conclusions on the basis of such data is misleading. *Cancer should be a reportable disease.*

AGE AND SEX

In a study of the individual case, age and sex are of little diagnostic importance. They are of interest, however, in a statistical study. In this group there were 233 men and 17 women. The age groups are shown in table 1. The youngest patient, a woman, was 21 years old. The oldest patient treated by laryngofissure was 78 years of age; the oldest laryngectomized patient was 77 years old.

TABLE 1.—*Sex and Age at Time of Operation*

	21-29	30-29	40-49	50-59	60-69	70 or Over
Men.....	2	8	51	98	58	16
Women.....	4	2	0	7	4	0

HEREDITY

Although impressions commonly are misleading, I have long been impressed with the idea that there is a hereditary tendency in cancer. There was a history of cancer occurring within two generations in 41 instances. In 32 of these, there was 1 case of cancer in the family; in 5 cancer occurred in 2 members, and in 4 it occurred in 3 members. In 1 of the last group, the case of a man on whom laryngectomy was done for extensive carcinoma and who ultimately died from metastasis to the regional lymph nodes, there was a history of 2 brothers who died from cancer of the larynx and 1 sister who died of pelvic carcinoma. In 2 cases of early cancer treated by laryngofissure there was a history of cancer of the breast. In 1 the mammary lesion occurred about two years before the laryngeal cancer and appeared to have been successfully treated. In the other the cancer occurred within one year after laryngofissure, and the patient ultimately died from cancer of the breast without any evidence of laryngeal recurrence or metastasis to regional lymph nodes.

BENIGN TUMORS OF THE LARYNX

There were 3 patients who had papilloma of the larynx removed two or more years prior to occurrence of the laryngeal cancer. Leukoplakia, which often is described as a predisposing factor, was observed in 2 cases, in 1 five and in the other six years before the cancer was discovered. In 1 of these there also was extensive leukoplakia of the mucosa of the cheek and alveolar process. The patient had a laryngo-

fissure in 1928, without recurrence to date. The gingival and alveolar leukoplakia still persists and has exhibited no evidence of malignant change.

OCCUPATION

Excessive use or abuse of the larynx probably is a predisposing factor. The occupation of 59 patients necessitated excessive use of the larynx; 18 patients were railroad employees who frequently were exposed to smoke, coal gases and dust. In 17 cases there was a history of frequent attacks of hoarseness for five or more years before a diagnosis of cancer was made. There were 3 physicians in the series.

DIAGNOSIS

While the diagnosis of cancer was based on the history, examination of the larynx by mirror laryngoscopy and direct inspection when indicated, together with additional studies, the final diagnosis in every case was based on the histologic study of tissue removed by direct laryngoscopy. In cases in which a specimen was not considered ample or representative or the histologic diagnosis and the clinical impressions were at variance, another specimen was taken, and the biopsy was repeated. Difficulty in securing a satisfactory view of the lesion or an adequate specimen of tissue was experienced particularly in the cases of subglottic growth. In these the employment of a 6 mm. bronchoscope passed through the laryngoscope in the anterior commissure often gave additional information.

In a diagnostic study it is important to determine the extent of the lesion. The lowermost limits of a growth often cannot be determined in stenotic lesions. Retrograde laryngoscopy through the tracheal fistula may be practiced if tracheotomy becomes necessary for relief of obstructive laryngeal dyspnea.

Tuberculosis or syphilis may simulate cancer of the larynx, or may occur concomitantly with it. In 1 patient there was clinical and roentgen evidence of an apparently quiescent tuberculous lesion in the lung. After laryngectomy the growth was studied microscopically, and a small area of tuberculous involvement was observed. Later, metastasis occurred to the cervical lymph nodes. These were removed by block dissection and were found to exhibit the histologic picture of cancer and tuberculosis. The patient died from cancer. In a second case a minimal pulmonary lesion became active, and the patient died from pulmonary tuberculosis.

A positive Wassermann reaction was present in 5 cases. In none was there observed in the larynx a lesion that suggested syphilitic infection. In considering the plan of investigation in the case of a patient

with suspected cancer of the larynx who also has a positive Wassermann reaction, biopsy should not be unduly delayed to ascertain the effects of antisyphilitic treatment on the laryngeal lesion.

GRADING

Information concerning the degree of malignancy based on Broders' classification is of value. Pathologists, however, are not agreed that an accurate opinion concerning the grade or degree of malignancy can be given on the basis of study of the small specimen submitted for examination. In a number of cases comparisons between the biopsy specimen and sections secured from the growth removed surgically indicated that, while the diagnosis could be made on the relatively small biopsy specimen, it was not always representative so far as the degree of malignancy was concerned. The late Dr. B. L. Crawford preferred to

TABLE 2.—*Degree of Malignancy*

Cases of laryngofissure			149
Low Degree	Intermediate	Anaplastic	
35	102	12	
Cases of laryngectomy			101
Low Degree	Intermediate	Anaplastic	
12	84	5	

classify the cases into three groups, and this plan has been followed in this series of cases, with the results shown in table 2.

While the anaplastic conditions are considered unsuitable for operative treatment, it is of interest to note that there were no local laryngeal recurrences in the 12 patients who were treated by laryngofissure. Of these, 5 have been well without recurrence for periods varying from ten to seventeen years. Two died from metastasis to the cervical lymph nodes occurring two and one-half years after operation, without recurrence in the larynx. In the third there was metastasis to the cervical lymph nodes two years after laryngofissure. A block dissection was performed four years ago, and there has been no recurrence to date. In another patient cancer of the thyroid gland developed five years after laryngofissure, with no local laryngeal recurrence. The type and grade of the malignant growth were identical with those of the primary laryngeal lesion. This patient died. In another patient who died there was no local recurrence and no metastasis to the regional lymph nodes. Small subcutaneous nodules developed, beginning three and one-half years after laryngofissure. One of these was excised and exhibited histologic appearances identical with those of the primary laryngeal cancer.

Approximately 180 nodules developed, many of which were treated with radon seeds by Dr. George E. Richards, of the Toronto General Hospital. The patient ultimately died five years after the primary laryngeal operation. One patient died from apoplexy after three years without evidences of local recurrence. The remaining patient has been treated within one year and, although free from recurrence, will not be considered.

In the 5 cases of anaplastic cancer treated by laryngectomy, 3 patients died after metastasis to the cervical lymph nodes, 2 within one year and the third four and one-half years after operation. One died from pneumonia three and one-half years after operation, without recurrence, and the fifth has been operated on within one year of the time of writing and remains well.

ANATOMIC CLASSIFICATIONS

The location of the primary growth is an important determining factor in the plan of treatment. Of the 149 cases in which laryngofissure was the procedure employed, the site of the primary growth was as follows:

Limited to one vocal cord	113
Extension across anterior commissure to opposite vocal cord	16
Subglottic region	18
Arytenoid cartilage	2
	149

In the laryngectomized group it often was difficult to ascertain the primary site, for in many the entire anterior portion of the larynx was involved (fig. 1 *A*). It was possible, however, to classify certain of these, as follows:

Epiglottis	5
Subglottic region	11
Postcricoid area	1
Interior of larynx (presumably intrinsic)	84
	101

Epiglottic growths may be removed by the transhyoid route if the lesion is small. In the 5 cases in this series the lesions were extensive, the growth extending downward to the level of the ventricular bands (fig. 1 *B*).

Subglottic lesions often become extensive before laryngeal symptoms are manifested. The extent of involvement also is difficult to ascertain either by mirror or by direct laryngoscopy and usually is underestimated. It may be necessary to resort to thyrotomy before one can decide on the type of operation to employ. Among the 18 cases in which the cancer was treated by laryngofissure there were 8 recurrences, 4 being in the larynx, one in the trachea and 3 in the cervical lymph nodes. In the laryngectomized group there were 11 subglottic lesions. In 3 it was

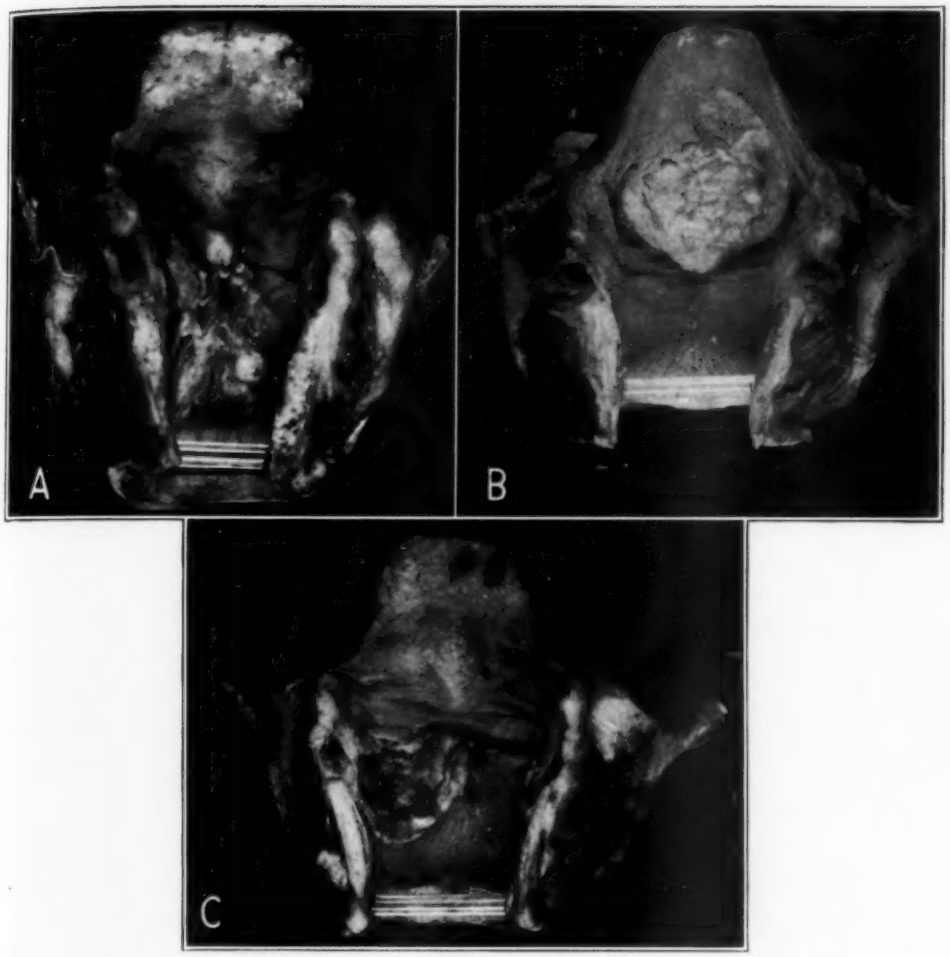

Fig. 1.—*A*, extensive cancer involving the entire left side of the larynx from the base of the epiglottis to the subglottic region and extending across the midline anteriorly to the right side. There had been hoarseness for seventeen months. It is probable that this began as a cordal lesion. *B*, squamous cell carcinoma involving the epiglottis of a man aged 37 years. Symptoms of a sticking sensation referable to the throat had been present for about ten weeks and had been attributed to swallowing a fish bone. There were slight changes in the voice. The vocal cords were not involved, but on phonation the lower end of the growth made contact with them and acted as a damper. *C*, subglottic cancer occurring in a man aged 45 years. It necessitated amputation of the trachea between the first and second tracheal rings. Vocal disturbances, consisting at first of huskiness in the evening and later of hoarseness, were of three months' duration. In this patient a recurrence developed along the posterior wall of the trachea at the level of the fifth and sixth rings, and he ultimately died.

necessary to include removal of the first ring of the trachea to secure an ample margin of tissue (fig. 1 *C*). In 1 the growth recurred in the trachea, and in 3 there was metastasis to the cervical lymph nodes.

In the 2 cases of cancer of an arytenoid cartilage it was decided to remove the primary growth, together with a wide margin of normal tissue, without sacrificing the larynx. Both tumors exhibited a high degree of malignancy. Both terminated fatally, one in two and one-half years from metastasis to regional lymph nodes and the other from generalized subcutaneous metastasis five years after operation. In neither was there local laryngeal recurrence. Laryngectomy, therefore, would not have offered more than laryngofissure.

TABLE 3.—*Recurrence of Cancer After Laryngofissure*

Number	Site of Recurrence	Time After Operation		Result
		Years	Months	
6	Larynx	..	11	Death
17	Trachea	..	8	Death
18	Larynx	12	..	Laryngectomy, 5 months ago
27	Lymph nodes	2	3	Death
31	Larynx	3	5	Laryngectomy; death
37	Larynx	1	1	Death
42	Larynx	3	3	Death
43	Larynx	1	2	Laryngectomy; death 7 years later, unrelated to cancer
45	Larynx	7	1	Death
46	Lymph nodes	7	8	Death
48	Subcutaneous nodes	3	6	Death
49	Thyroid gland	5	..	Death
50	Lymph nodes	1	11	Death
53	Larynx	..	11	Laryngectomy; death
61	Larynx	..	9	Laryngectomy; well 8 years
70	Lymph nodes	2	9	Death
80	Lymph nodes	1	2	Block dissection; well over 4 years
81	Lymph nodes	3	2	Death
82	Larynx	..	3	Laryngectomy; death 2 years later; recurrence to spine
83	Larynx	..	8	Laryngectomy; well 4½ years

In only 1 case of postcricoidal cancer was the growth treated surgically. Metastasis to the lymph nodes and to the mediastinum, with death, occurred in one year. The results of surgical treatment of cancer originating outside the larynx have been unsatisfactory, and I believe that irradiation should be employed.

RECURRENCES

Recurrences Following Laryngofissure. — Although cancer may recur many years after removal of the primary growth, experience has shown that this is uncommon after the fifth year following operation, and in a majority of cases it occurs within three years. Table 3 indicates the number, the site and time of recurrence of cancer after operation and the results in a group of 86 cases in which operation had been done five or more years previously.

Summary.—From table 3 it will be seen that there were 20 recurrences, 17 of which were observed within five years, as follows: 11

tumors recurred in the larynx, 5 within one year and 2 after seven and twelve years respectively; 6 metastasized to the cervical lymph nodes, and the remaining 3 involved the trachea, the thyroid gland and the subcutaneous nodes. Of the 11 cases of local recurrence, laryngectomy was performed in 7, with metastasis in 3 and recovery without recurrence in 4, the interval varying from four and one-half to eight years in 3 cases and five months in 1 case. (Laryngectomy was performed in the last-mentioned case by Dr. Murdock Equen.) In the 6 cases of metastasis to lymph nodes, there was 1 recovery after four years, following a block dissection. The total number of deaths from cancer in the 86 cases of laryngofissure was 15.

TABLE 4.—*Recurrence of Cancer After Laryngectomy*

Number	Site of Metastasis	Time		Result
		Years	Months	
1	Lymph nodes	.	6	Death
5	Lymph nodes	1	1	Death
7	Lymph nodes	5	2	Death
8	Mediastinum	1	1	Death
9	Lymph nodes	..	7	Death
11	Lymph nodes	4	9	Death
12	Lymph nodes	..	5	Death
15	Thoracic esophagus and lung	5	7	Death
24	Lymph nodes; later, lung	3	8	Block dissection; died 2 years later from pulmonary carcinoma
25	Lung	3	2	Death
26	Lymph nodes	..	10	Death
28	Lymph nodes	1	4	Death
31	Lymph nodes	..	10	Death
32	Lung	2	1	Death
34	Mediastinum	1	..	Death
35	Mediastinum	..	9	Death
37	Lymph nodes	..	8	Death
38	Lung	2	8	Death
50	Lymph nodes	1	2	Death
51	Lymph nodes	1	6	Death

Of the group of patients operated on between three and five years ago, totaling 18, there have been recurrences in the larynx in 2 cases. In both laryngectomy was performed, with no recurrence for two and two and one-half years respectively. In 45 patients operated on by laryngofissure during the past three years there have been recurrences in the larynx in 3 and metastasis to lymph nodes in 2.

Recurrences Following Laryngectomy.—Results following laryngectomy are dependent on the type of growth one accepts for operation. Many lesions are extensive, and the laryngeal cartilages often are involved. With these, metastasis commonly occurs. In table 4 are shown the site and time of occurrence of metastases and the end results.

Summary.—In the first 27 cases operation had been done from five to twelve years previously and in the cases beginning with case 28, from three to five years prior to the time of this report. Of the 20 recurrences, 13 occurred in regional lymph nodes; 3 involved the mediastinal

structures; 3 occurred in the lungs and 1 involved the lung and the lower thoracic portions of the esophagus. In the last-mentioned case the histologic appearance of tissue removed from the esophagus was identical with that observed in the larynx, although the esophageal lesion appeared as a discrete fungating growth. In 1 case of metastasis to lymph nodes occurring three and one-half years after laryngectomy block dissection was performed. The patient died two years later from pulmonary involvement.

Postoperative Complications.—The most common causes of postoperative complications are pulmonary or cardiovascular. Careful pre-

TABLE 5.—*Deaths Following Laryngofissure*

Number	Age	Number of Days After Operation	Cause of Death
4	54	8	Diabetes mellitus; bronchopneumonia
11	70	5	Coronary thrombosis
20	68	4	Chronic myocarditis
24	51	11	Apoplexy
26	65	6	Chronic nephritis; chronic myocarditis
44	68	2	Chronic myocarditis; pulmonary edema
101	74	8	Bronchopneumonia

TABLE 6.—*Deaths Occurring Within Thirty Days After Laryngectomy*

Number	Age	Number of Days After Operation	Cause of Death
4	41	24	Bronchopneumonia
67	64	13	Bronchopneumonia; bacterial endocarditis
81	59	21	Coronary thrombosis
84	45	9	Bronchopneumonia
92	58	10	Bronchopneumonia
98	52	1	Cerebral and pulmonary embolism

operative preparation, selection of the anesthetizing agent, avoidance of inspiration of blood and secretion into the trachea during operation and proper postoperative care will prevent serious and often fatal complications.

In the series of 149 laryngofissures there were 7 postoperative deaths, 6 of which occurred in the first 44 cases. The employment of general anesthesia, tracheotomy and packing of the larynx in the earlier cases undoubtedly contributed to the high mortality rate.

Local anesthesia is now routinely employed. Hemorrhage is promptly controlled, and packing is not employed. Tracheotomy is resorted to during the operation only if an extensive removal is contemplated. As a result the operative mortality has been reduced to 1 death in the last 105 laryngofissures.

Pulmonary complications occurred more often after laryngectomy. These probably resulted from employment of general anesthesia, inspiration of blood into the bronchi during operation and failure to get rid of bronchial secretions postoperatively. Six deaths occurred in 101 cases within thirty days after laryngectomy. Curiously, there was but 1 death in the first 66 cases, and 5 occurred in the remaining 35 cases. Four of these resulted from bronchopneumonia.

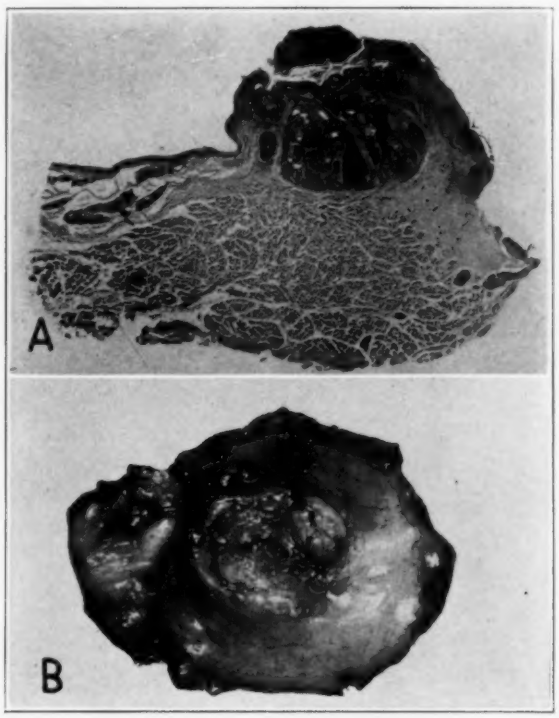

Fig. 2.—*A*, photomicrograph (×7) of tissue removed at laryngofissure. The specimen includes the entire primary carcinoma, the surrounding normal tissue and muscle extending to the perichondrium. By mirror laryngoscopy the growth appeared as a rounded nodule on the edge and upper surface of the vocal cord at the junction of its middle and anterior thirds. *B*, specimen (×2) of cancer of the right vocal cord removed by laryngofissure. The growth, an ulcerated lesion, involved the upper surface and edge of the cord and extended to the anterior commissure. It did not extend to the opposite vocal cord. Surrounding normal tissues, including the subglottic tissues to the cricoid cartilage below and the vocal cord including the vocal process posteriorly, were removed. Above it included the edge of the ventricular band as well as the entire ventricle. All of the tissue in the anterior commissure as well as a segment of the left vocal cord was removed. The outer limits included the internal perichondrium.

Local anesthesia has been employed in some of the recent cases, and it is believed that routine employment of this will aid materially in reducing the bronchopulmonary complications.

OPERATIVE PROCEDURES

Laryngofissure.—Irrespective of the social and economic advantages that will accrue to the patient, the excellent results secured in the treatment of true cordal cancer by laryngofissure indicate that this is the procedure of choice (fig. 2*A*). In this study there were 17 recurrences in the larynx among 149 cases. Four of these occurred in subglottic lesions, and in 9 instances the primary growth involved a vocal cord

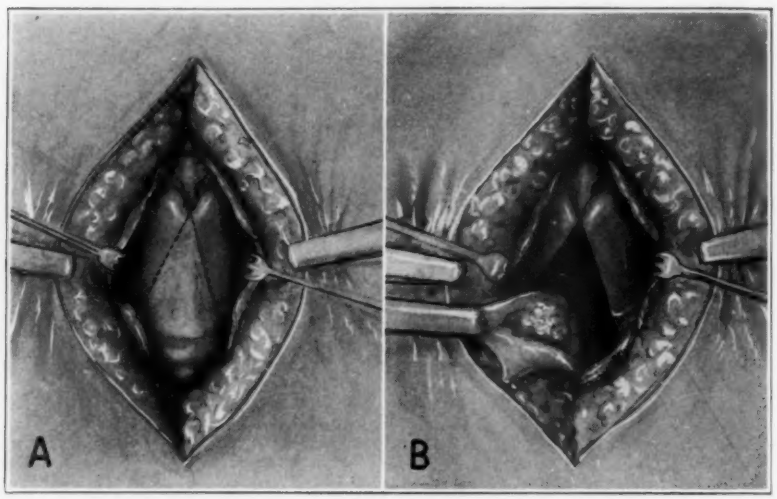

Fig. 3.—*A*, operative sketch. The dotted line indicates the triangular segment of cartilage to be removed. The soft tissues attached to the inner aspect of this cartilage are not separated from it. The trachea is opened along the upper border of the cricoid cartilage through the cricothyroid membrane, and the membrane corresponding to the base of the triangular segment of cartilage is included in the tissues to be removed. The interior of the subglottic larynx may be readily inspected through this opening with the aid of a laryngeal mirror. The vocal cord with the lesser involvement is then incised and the mass reflected to the opposite side. The other cord then may be inspected and a sufficient portion separated by subperichondrial dissection and amputated. *B*, operative sketch. In this illustration the left vocal cord has been incised well beyond the posterior limits of the growth. The excision includes the triangular segment of thyroid cartilage and the cricothyroid membrane attached to it. The right vocal cord will next be incised and separated, together with the internal perichondrium.

and extended into the anterior commissure to the anterior extremity of the opposite cord. It is obvious that these recurrences resulted from

incomplete removal of the cancer, in spite of the belief that an adequate margin of normal tissue surrounding the growth had been removed (fig. 2*B*).

The close proximity of the cricoid cartilage to a subglottic growth and the desirability of retaining this cartilage intact in laryngofissure often account for an incomplete removal. I am now convinced that subglottic cancer should be treated by laryngectomy unless the growth is small and has not extended to within 0.5 cm. of the lower border of the thyroid cartilage. A small growth in the anterior commissure can, I believe, be successfully treated by laryngofissure if the anterior angle

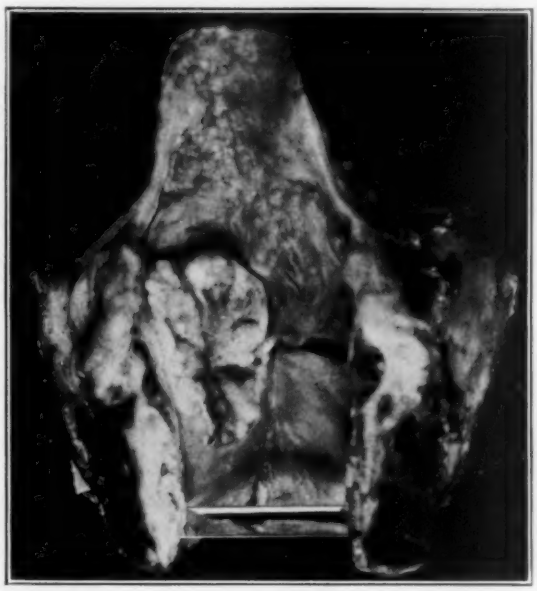

Fig. 4.—Papillary type of cancer involving the larynx of a man aged 59 years. There was a history of hoarseness of twenty months' duration. By mirror laryngoscopy the growth appeared to originate on the left vocal cord and extended from the anterior commissure to the anterior surface of the arytenoid as well as above the left ventricular band. There was marked encroachment on the airway, and it was not deemed advisable to pass the anterior commissure laryngoscope through the glottis. At operation a horizontal incision was made through the cricothyroid membrane and the subglottic larynx inspected. The large subglottic extension of the growth on the left side was observed, and amputation of the trachea was then performed between the first and second rings.

of the thyroid cartilage and a corresponding portion of the cricothyroid membrane are removed together with the growth and an adequate segment of each vocal cord. In order to do this it is necessary to remove a triangular portion of the thyroid cartilage instead of making the customary midline fissure (fig. 3*A*). This can be readily accom-

plished with the laryngeal saw. If the upper border of the thyroid cartilage is left intact there will be little tendency to development of stenosis of the larynx. The segment of cartilage and all of the soft tissues are removed en masse (fig. 3 *B*).

Laryngectomy.—The conventional midline incision is employed, and the larynx is skeletonized in the usual manner. The larynx is amputated between the cricoid cartilage and the first tracheal ring and removed from below upward. To provide an adequate margin of normal tissue between the growth and the point of amputation, the subglottic portion

Fig. 5.—Extensive carcinoma involving the epiglottis and anterior extremity of both ventricular bands and vocal cords together with marked edema of arytenoids and aryepiglottic folds. The patient received intensive preoperative irradiation. Although there has been no recurrence twenty-three months after laryngectomy, there still persists a pharyngeal stoma. In spite of an unfavorable prognosis, laryngectomy was accepted by the patient because of severe pain referred to the left ear, pain in the region of the larynx and painful and difficult swallowing.

of the larynx is inspected with the aid of a small laryngeal mirror introduced through a slit between the cricoid cartilage and the first tracheal ring before the amputation is completed (fig. 4). The hyoid bone is removed routinely. This procedure is carried out according to the technic of Bisi.[2] This assures complete removal of the preepiglottic

2. Bisi, R. H. Laryngeal Cancer: Its Surgical Treatment, Buenos Aires, "El Ateneo," 1938.

tissues, including lymph nodes which may be the site of metastasis, particularly in lesions involving the base of the epiglottis, the anterior commissure or a ventricular band. In 2 of the earlier cases of laryngectomy without removal of the hyoid bone there was recurrence of the

TABLE 7.—*Summary of End Results*

A. LARYNGOFISSURE		
Postoperative deaths in entire series of 149 cases		7
Number of cases of laryngofissure performed between 5 and 17 years		86
Patients living and free from recurrences		47
(This includes 5 patients with recurrences, 4 of whom were operated on by laryngectomy and 1 by block dissection of cervical lymph nodes)		
Postoperative deaths		6
Deaths from causes unrelated to cancer		16
Unable to trace		2
Recurrences		20
Deaths from recurrences	15	
Laryngectomy performed for recurrences	7	
Patients living and well after laryngectomy for recurrences	4	
Block dissection for metastasis to cervical lymph nodes	4	
Patients living and free from recurrences after block dissection	1	
Number of cases of laryngofissure performed between 3 and 5 years ago		18
Patients living and free from recurrences (this includes 2 patients who had laryngectomy performed for recurrence)		15
Postoperative deaths		1
Deaths from causes unrelated to cancer		1
Unable to trace		1
Recurrences		2
Deaths from recurrences	0	
Laryngectomy performed for recurrences	2	
Patients living and well after laryngectomy for recurrences	2	
(In the remaining 45 cases laryngofissure was performed less than 3 years ago and they are therefore not included in the summary of end results.)		
B. LARYNGECTOMY		
Postoperative deaths in the entire series of 101 cases		6
Number of cases of laryngectomy performed 5 or more years ago		27
Patients living and free from recurrence		11
Deaths occurring within 30 days after operation		1
Deaths from causes unrelated to cancer		4
Unable to trace		0
Deaths from recurrences		11
Number of cases of laryngectomy performed between 3 and 5 years ago		28
Patients living and free from recurrences		15
Deaths occurring within 30 days after operation		0
Deaths from causes unrelated to cancer		4
Unable to trace		0
Deaths from recurrences		9
(In the remaining 46 cases of laryngectomy operation was performed less than 3 years ago and they are therefore not included in the summary of end results.)		

cancer in the region of this bone. It is believed that clearing out of the preepiglottic space would have prevented the recurrences. Counter-drains consisting of a small rubber tube and a covered gauze wick are placed on each side of the midline incision. The distal ends are secured laterally to avoid their contact with the pharyngeal and skin suture lines.

Irradiation.—Four patients had preoperative irradiation elsewhere before operation was contemplated. In 1 the growth disappeared com-

pletely but recurred in eight months. Two additional courses of irradiation then were given, with no beneficial effects, and laryngectomy was advised (fig. 5). The larynx was removed twenty-three months ago, and there has been no recurrence to date. There still remains a pharyngeal stoma in spite of attempts at plastic closure. Postoperative irradiation in the form of roentgen ray, radium or radon has been employed either as a precautionary measure or in the treatment of recurrences. It is difficult to evaluate the results. In cases of known recurrence there have been no cures.

CONCLUSIONS

End results of surgical treatment of cancer of the larynx are influenced by the extent of involvement, the location of the growth and the degree of malignancy.

True cordal cancer should be treated by laryngofissure; cancer limited to the anterior commissure may be successfully treated by laryngofissure if a large segment of the overlying thyroid cartilage is removed; laryngectomy gives better results than laryngofissure in cases of subglottic cancer.

Employment of local anesthesia, prevention of inspiration of blood into the tracheobronchial tree during operation and prompt aspiration of secretions from the trachea after operation will decrease the incidence of postoperative pulmonary complications.

While the problems of anesthesia and preoperative and postoperative management and certain technical differences in the surgical management are important, the outstanding problems from the standpoint of end results consist of prompt recognition and early diagnosis of cancer, so that appropriate treatment may be instituted without delay.

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OSTEOMA OF THE MAXILLARY SINUS

REPORT OF A CASE

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As a general medical problem, osteoma of the nasal accessory sinuses is not a common condition. In most cases it originates in the frontal or ethmoid sinuses. An osteoma of the maxillary sinus is rare and for this reason, if no other, is of especial interest.

In 1938 [1] I reviewed this subject in detail. In the present paper I should like to emphasize some of the more important points and offer additions from the literature compiled since that time. I want also to report another case which has come under my observation.

An osteoma is a more or less encapsulated, bony tumor, attached to the bone from which it arises. It may displace the surrounding structures mechanically but does not invade by cellular extension and does not metastasize. An osteoma should not be confused with a simple inflammatory exostosis, syphilitic exostosis or leontiasis ossea. Osteomas vary considerably in size and somewhat in rate of growth. It is difficult to determine the rate of the growth in some cases, because often there are no early symptoms and a diagnosis is not made until there is displacement of the surrounding structures. In most cases, however, the tumor grows slowly. Trauma or infection may increase the activity of the growth.

Of the many theories advanced concerning the development of osteomas, Fetissof's [2] is still the most sound and logical. His excellent work indicates that the tumors develop from the periosteum, split off during the stage of development of the organism. He expressed the belief that in order to produce the osteoma an external irritant may also be necessary, together with the periosteum split. Malan's [3] recent detailed

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Read at the meeting of the Western Section of the American Laryngological, Rhinological and Otological Society, Los Angeles, Jan. 27, 1940.

1. Rawlins, A. G.: Osteoma of the Maxillary Sinus, Ann. Otol., Rhin. & Laryng. **47**:735, 1938.

2. Fetissof, A. G.: Pathogenesis of Osteomas of the Nasal Accessory Sinuses, Ann. Otol., Rhin. & Laryng. **38**:404, 1929.

3. Malan, E.: Chirurgia degli osteomi delle cavità pneumatiche perifacciale (contributo anatomo-clinico), Arch. ital. di chir. **48**:1, 1938.

article in Italian would indicate that the two common irritants are: (1) injury and (2) infection. Fetissof [2] concluded that the growth of the tumor takes place from the inside outward, by metaplasia of the fibrous tissue into osseous tissue, and that the osteoblastic activity that takes place at the periphery plays only a secondary role.

The tumors may consist of hard compact bone, spongy bone or a combination of the two types. The pedicle is usually spongy. The microscopic picture differs from that of the normal bone mostly in the irregular formation of the structure. There is a mucoperiosteal covering which dips down into the tumor mass. The hard compact bone is characterized by compact lamellas, poverty of haversian canals and lack of medullary spaces. The spongy type is characterized by numerous medullary spaces interspersed with irregular areas of connective tissue. Osteoclastic and osteoblastic activity may be present, according to whether the tumor is young and growing or old and more or less stationary.

The main symptoms, if any are present, are the following: (1) swelling of the cheek and of the upper part of the alveolus, (2) exophthalmos with the eyeball pushed upward, (3) pain, (4) epiphora, (5) diplopia and even (6) loss of vision. Suppuration of the antrum may be present.

The commonest pathologic conditions to think of in making the differential diagnosis are: (1) malignant growths, (2) osteomyelitis, (3) cystic tumors and (4) fibromas, especially if they are calcified.

This is one condition which is diagnosed mainly on the basis of roentgenograms.

The treatment is always surgical and is simple if the tumor is not allowed to become too large. Either the Caldwell-Luc or the Denker approach may be used, and it should be remembered that the pedicle, along with some bone from which the pedicle arises, should be removed to insure against the recurrence of the tumor.

Malan,[3] in his careful review of the literature, found 24 cases in which the condition was definitely osteoma of the antrum and 17 others in which it probably was. He estimated the percentage at 8.9. In the review made by myself [1] in 1938, I found 27 cases, and I reported 2 others, making a total of 29. No others have been reported since that time. However, in checking Malan's [3] excellent bibliography I have found that 3 cases were overlooked by me. These 3 raise the total to 32. The cases missed were those of Ghazy,[4] Guazzieri [5] and Porto.[6]

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4. Ghazy, S.: Un cas d'ostéome volumineux de la mâchoire supérieure operé et guéri, Marseille méd. **1**:553, 1927.

5. Guazzieri, G.: L'osteoma del seno mascellare, Incurabili, 1935; abstracted, Policlinico (sez. prat.) **43**:2040, 1936.

6. Porto, G.: Osteoma esponjoso do maxilar superior, Arq. inst. Penido Burnier **3**:223, 1934.

In a recent article by Eden,[7] on the "fibro-osseous tumors of the skull," he made a classification of (1) ossifying fibromas, (2) fibrous osteomas, (3) compact osteomas and (4) diffuse osteomas. The tumors under his grouping of "compact osteomas" are the ones included in my original definition of osteoma. While he reported some cases in the other groups, he did not give any case reports of true "osteoma of the maxillary sinus." His article is instructive and throws a new light on the classification of these conditions.

Fig. 1.—Roentgenogram of the tumor in the antral cavity.

Following is a report of another case which has recently come under my observation:

REPORT OF CASE

H. T. D., a man aged 35 years, complained of a painless swelling of the right side of the face and palate. The condition had appeared ten years previously, about one year after the extraction of all his teeth. The swelling necessitated shaving down his upper dental plate at intervals, in order to keep it fitting properly.

Examination.—There was a hard, rounded swelling occupying the right canine fossa. The mass extended from near the orbital rim down to the alveolar process

7. Eden, K. C.: The Benign Fibro-Osseous Tumors of Skull and Facial Bones, Brit. J. Surg. **27**:323, 1939.

and from the piriform sulcus laterally about as far as the external canthus. It was covered with normal buccal mucous membrane.

The roentgenographic report (figs. 1 and 2), by Dr. J. Howarth and Dr. Harry Garland, was as follows: "There is a rounded, calcified density occupying the

Fig. 2.—Another roentgenographic study of the tumor shown in the preceding figure.

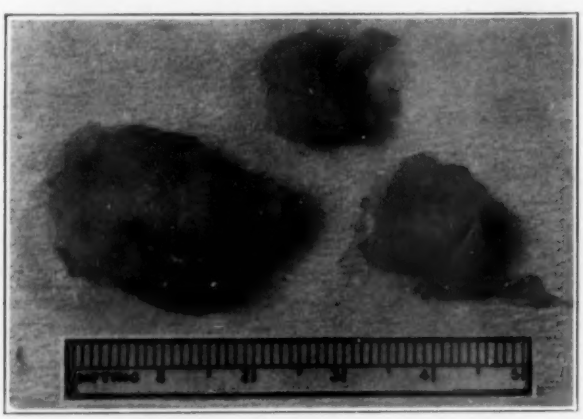

Fig. 3.—Photograph of the excised osteoma.

inferior mesial wall of the right antrum and right alveolar ridge, in the cuspid and bicuspid area. This would appear to be a bengin tumor, probably arising in the alveolar ridge, presumably an osteoma or osteochondroma." The remaining sinuses were clear.

Results of the general physical examination and of the laboratory tests, including the Wassermann test, were all normal.

Operation and Course.—On Sept. 19, 1939 I operated on the right antrum, using the Caldwell-Luc approach, and with the region under local anesthesia I removed a bony tumor about the size of a large walnut (fig. 3). The tumor was an osteoma and filled about one half of the antral cavity. It was attached to the

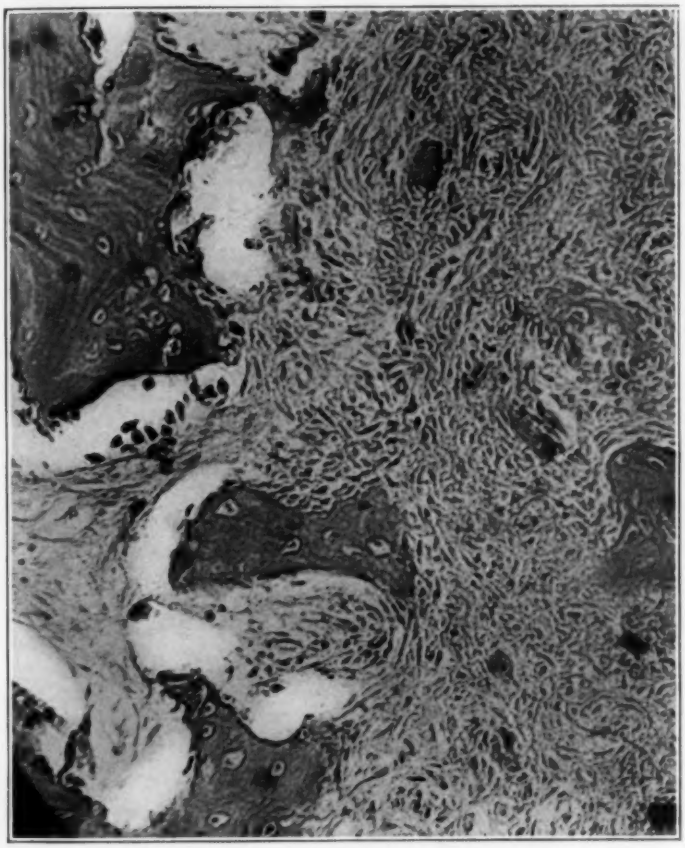

Fig. 4.—Photomicrograph of the osteoma.

alveolus and the anterior antral wall by a large pedicle and covered with normal antral mucous membrane.

After the tumor was taken out the remaining membrane was also removed, there being a mucous cyst in the roof of the antrum. A large opening was made into the nasal cavity under the inferior turbinate. The cavity was packed with iodoform gauze and the incision in the canine fossa closed. An alveolar fistula resulted from the operation. On Nov. 2, 1939 I closed this fistula, and the patient has had no symptoms since that time.

Examination of Tumor.—Dr. David Wood described the tumor as follows (fig. 4):

"Gross Specimen: The tumor consists of several irregularly oval pieces of bone, the largest of which measures 2 cm. in diameter. One piece of thin flat bone, presumably the floor of the antrum, is covered on one aspect by mucous membrane. This piece of tissue measures 1 cm. in width

"Histologic Examination: Sections taken from different areas show a pleomorphic picture. In areas the tumor is composed of rather closely packed spicules of cancellous bone possessing poor cytologic detail and only occasional poorly defined lacunas. The spicules are separated from one another by fibrous tissue in which the cells are small and in which there has been considerable production of collagen. Some of this fibrous tissue shows an osseous metaplasia. In one section,

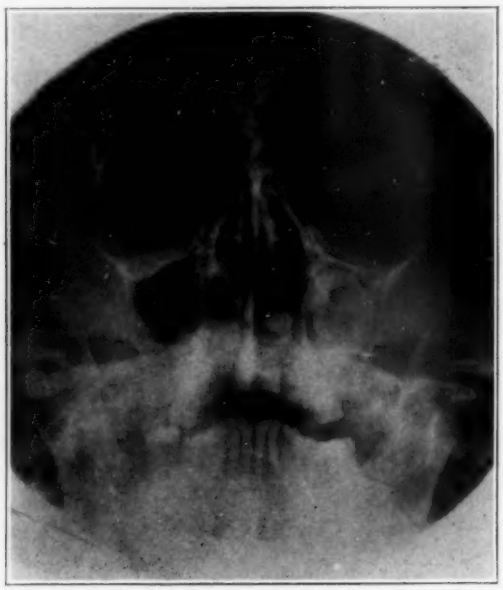

Fig. 5.—Roentgenogram of the osteoma of the antrum occurring in the case previously reported.

the tumor just described is attached to cancellous bone of the antral wall, covered by mucous membrane. The line of attachment is thin and composed of fibrous tissue. There is a striking contrast between the normal appearing cancellous bone of the maxilla and the cancellous structure of the osteoma.

"In another section, the bony spicules are better defined and among them are some which appear to be quite normal with numerous well formed lacunas. In those areas, the intervening fibrous tissue is more cellular and supports occasional thin-walled, congested capillaries. Osteoblastic activity is not evident. It would seem that the bony tissue is metaplastic in its origin. The diagnosis is that of a compact, adult type of osteoma of the maxillary sinus."

COMMENT

In my first case,[1] reported in a previous paper (figs. 5 and 6), the osteoma sprang from near the same region as that in which the lesion arose in the case just reported. The pedicle was attached at the exact spot where a nail had accidentally been run through the hard palate into the antrum. In the case reported in the present paper the tumor developed after the extraction of teeth.

In other words, traumatic irritation was a possible etiologic factor in both cases. This would lend support to Fetissof's [2] theory that irritation

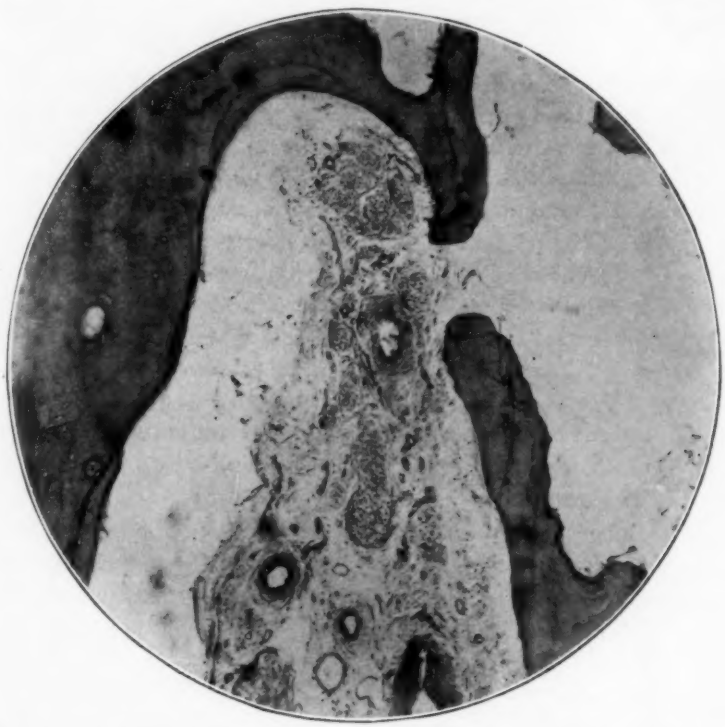

Fig. 6.—Section of the osteoma occurring in the case previously reported (× 100).

may be necessary along with the periosteum split in order to produce the osteoma. Furthermore, the microscopic picture of the osteoma in the case just reported supports Fetissof's [2] idea that the tumor develops from inside outward by metaplasia of the fibrous tissue into osseous tissue.

It is not known why this condition is so rare in the maxillary sinus. It is known, however, that it is also rare in the sphenoid sinus and comparatively common in the frontoethmoid region. I believe that an embryologic study might reveal the explanation of this diversity.

BRITTLE BONES ASSOCIATED WITH DEAFNESS AND BLUE SCLERAS

REPORT OF THE SYNDROME IN TWO PERSONS OF ONE FAMILY

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AND
SAMUEL J. SWEET, M.D.
MILWAUKEE

The syndrome of brittle bones, blue scleras, relaxed ligaments and deafness is an interesting hereditary condition which to the otologist is of particular interest because of the nature of the hearing impairment and its similarity to the deafness accompanying otosclerosis. Patients afflicted with this set of symptoms are usually first seen in the orthopedic service, because of frequent and multiple fractures, and the condition is promptly recognized by the blue scleras of the patients themselves and by the histories of frequent fractures both among the patients and among other members of the family. Reports in the literature regarding brittle bones and blue scleras have been numerous, but the associated deafness was reported first by van der Hoeve and de Kleyn [1] and later by Bronson.[2] These writers brought forth the interesting observation that persons with this syndrome have a tendency to become deaf in the third or fourth decade of life.

It is the purpose of this paper to present the history and findings of 2 cases, those of a brother and sister, both of whom have blue scleras and definite hearing impairment and have sustained multiple fractures.

REPORT OF CASES

CASE 1.—W. Z., a married man 31 years of age, was first examined on Aug. 29, 1939. He stated that his hearing had become progressively impaired since December 1938. He did not remember ever having any ear trouble or auditory deficiency prior to that time. In January 1939 he had his tonsils removed on the advice of his physician, in an attempt to improve his hearing; the hearing, however, became progressively worse. Except for the history of numerous fractures,

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1. (*a*) van der Hoeve, J.: Fragility of Bones and Disorders of Audition, Nederl. tijdschr. v. geneesk. **1**:1003 (March) 1917. (*b*) van der Hoeve, J., and de Kleyn, A.: Blaue Sclera Knochenbrüchigkeit und Schwerhörigkeit, Arch. f. Ophth. **95**:81 (Jan.) 1918.

2. Bronson, E.: Fragilitas Ossium and Its Association with Blue Sclerotics, Edinburgh M. J. **18**:240 (April) 1917.

the patient has been in good health. He has had no serious ailments requiring medical or surgical treatment. The first fracture occurred when he was 7 years old, and to date he has had twelve broken bones. He has 3 children, all of whom have blue scleras. The oldest child, a boy aged 9 years, has sustained three fractures; his audiometer curves show normal hearing. The second child, a girl aged 6 years, has sustained five fractures so far; her audiometer records too show normal hearing. The youngest child, aged 4 years, has sustained no fractures to date.

The general examination revealed the patient, who was of short stature, to be in good physical condition. The head was of the square type, and bilateral mastoid protuberances were noted. The scleras were blue, and the irides were grayish brown. The unaided vision in each eye was 0.6, and with correction 10/10. The optic disks were flat. The ear drums, except for a pinkish hue, showed normal landmarks. The nasal septum was deflected considerably to the right. The tonsils had been removed cleanly. Posterior rhinoscopy revealed patent eustachian tubes. The caloric tests showed the labyrinths to be slightly hypoirritable. The audiometer readings (fig. 1) revealed a 55.4 per cent loss of hearing in the right ear,

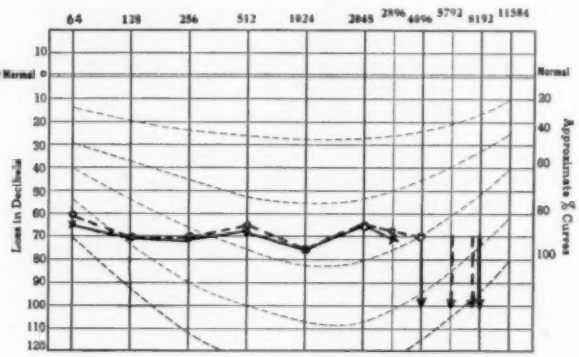

Fig. 1.—Audiogram for patient of case 1. The solid line represents the loss of hearing in the right ear and the broken line that in the left ear.

with complete loss at and above the frequency of 4096 cycles; the left ear showed a 54.2 per cent loss through that of 4096 cycles, which was the upper limit for that ear. The Weber test was not referred. The Schwabach test showed marked reduction of bone conduction on each side, but the reaction to the Rinne test was still negative for each ear.

The Kline test for syphilis and other laboratory tests gave normal results.

CASE 2.—G. T., aged 35 years, sister of W. Z., was examined in September 1939. She is married but has no children. She gave a history of impaired hearing for the past eleven years and no history of aural discharge or ear trouble in childhood. She has sustained five fractures of the extremities, the first of which occurred when she was 8 years old. Submucous resection of the nasal septum and tonsillectomy were performed ten years ago in an effort to preserve her hearing.

The general physical examination revealed a well developed, normal woman. The head showed bifrontal and biparietal eminences. The ear drums were intact, with normal landmarks. The eyes showed the typical blue scleras but were otherwise normal. Examination of the nasal septum revealed a large perforation of the

bony portion along the vomer. All of the patient's upper teeth had been removed because of infection. The tonsils had been cleanly removed. The eustachian orifices were patent. Caloric tests indicated normally functioning labyrinths. The audiometer readings (fig. 2) showed a loss of 40.5 per cent in the right ear up to and including the frequency of 4096 cycles. In the left ear the loss was 40 per cent up to and including 4096 cycles. The frequency of 5792 cycles and the levels above it were not heard in either ear. In the Weber test the sound was not referred. The Rinne test gave negative results on each side, and bone conduction was moderately increased in both ears.

The reaction to the Kline test for syphilis was normal.

COMMENT

The family history of the brother and sister is interesting and reveals the hereditary character of this syndrome. The father of the patients died from complications following a fracture. He was about 36 years

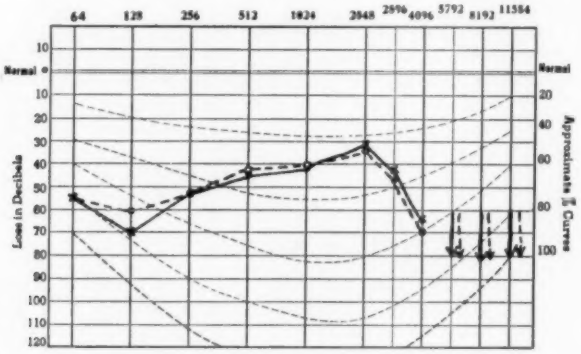

Fig. 2.—Audiogram for the patient of case 2. The solid line represents the loss of hearing in the right ear and the broken line that in the left ear.

old at the time of his death, and it is recalled that he had blue scleras and was hard of hearing. The mother, who died at the age of 66 years, did not have blue scleras, and at no time did she have any broken bones or auditory impairment. The history pertaining to the grandparents is unknown. In the generation of our patients, there were four brothers and three sisters, who are listed in order of their birth:

1. Sister, aged 42 years, married, with 5 children: There is no history of brittle bones, blue scleras or deafness; none of the 5 children show evidence of any symptoms.

2. Brother, death in childhood: The history is unknown.

3. Brother, aged 39 years, married, 1 child: He has had no deafness, blue scleras or fractures.

4. Sister, aged 37 years, married, 1 child: There is no history of deafness, blue scleras or fractures.

5. Sister, aged 35 years (case 2), married, no children: She has blue scleras, and the history includes broken bones, as well as auditory deficiency since the age of 24 years.

6. Brother, aged 31 years (case 1), married, 3 children: This man has blue scleras and gives a history of fractures and of impaired hearing of one year's duration.

7. Brother, death in infancy: The history is unknown.

The family tree, indicating the relationship of the features of the syndrome, is given in figure 3.

The cause of this interesting clinical syndrome is unknown, but its hereditary tendency following the mendelian law of inheritance has been shown in the writings of Hills and McLanahan [3] and Spurway.[4] Key [5] stated that the condition may be due to a hereditary hypoplasia of the mesenchyme, as it is noted that all of the symptoms are due to distur-

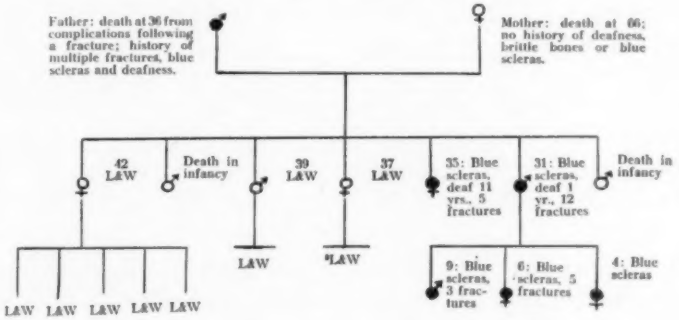
Father: death at 36 from complications following a fracture; history of multiple fractures, blue scleras and deafness.
Mother: death at 66; no history of deafness, brittle bones or blue scleras.
42 L&W
Death in infancy
39 L&W
37 L&W
35: Blue scleras, deaf 11 yrs., 5 fractures
31: Blue scleras, deaf 1 yr., 12 fractures
Death in infancy
L&W
L&W
9: Blue scleras, 3 fractures
6: Blue scleras, 5 fractures
4: Blue scleras
L&W L&W L&W L&W L&W

Fig. 3.—Family tree of the patients of cases 1 and 2.

bances of the mesenchyme, from which the bones, tendons, fibrous tissues and scleras are developed. As pointed out by Hills,[3] one expects 50 per cent of the children of a heterozygotic person with this condition mated with a normal person to have blue scleras, brittle bones or deafness; in turn, each affected person if mated to a normal one will have an equal number of affected and nonaffected children.

The persons with this syndrome, as a rule, are in good health. The shape of the head is characteristic, these patients usually having protuberances of the frontal and temporal bones. The tendency toward fractures may develop before or after birth, the disease when it occurs at the former time being called osteogenesis imperfecta and having a

3. Hills, R. G., and McLanahan, S.: Brittle Bones and Blue Scleras in Five Generations, Arch. Int. Med. **59**:41 (Jan.) 1937.

4. Spurway, J.: Hereditary Tendency to Fracture, Brit. M. J. **2**:844, 1896.

5. Key, J. A.: Brittle Bones and Blue Sclera: Hereditary Hypoplasia of the Mesenchyme, Arch. Surg. **13**:523 (Oct.) 1926.

serious prognosis for life. In most cases, however, fractures are not present at birth but occur throughout childhood until puberty, after which time, for reasons unknown, there is a definite decrease in the tendency toward fractures. Some of the characteristics of the fractures are (1) the ease with which they occur, (2) the absence, or small amount, of pain at the time of the fractures, which is probably due to the small amount of trauma to the soft tissues overlying the fracture, (3) the absence of any particular sites for the fractures and (4) the promptness with which healing takes place. Dislocation of the joints is not an uncommon occurrence and is due to the fibrous tissue structures which support the joints being loose and relaxed, thereby causing weakness of the joint and allowing for greater range of motion. As the result of the multiple fractures, deformities may take place together with warping of the spine or extremities. Investigations have been made of the endocrine glands and of the blood calcium and phosphorus values of these patients, all of which were usually found to be normal. Syphilis has been reported present in some cases, but it is not a causative factor.

The blue sclera is one of the outstanding features of this condition. It is striking, the color being a china blue. There still is a difference of opinion as to the anatomic cause of the blue scleras. It is commonly agreed that the color is imparted by the choroidal pigment, but whether this is caused by unusual transparency or by thinness of the sclera is still in dispute.

The auditory deficiency in this syndrome is usually associated with the name of van der Hoeve,[1] who revealed the nature of that deafness. It usually is a late manifestation, coming on in the late twenties. Heretofore it has usually been overlooked as a part of this syndrome, for at this age the tendency toward fractures is greatly lessened. The pathologic studies of the temporal bones have been few. Ruttin,[6] in 1922, reported the findings of a case of this syndrome in which the typical lesions of otosclerosis were noted in the petrous portion of the temporal bone. Cleminson[7] described a case of Dr. Nager's in which autopsy was performed, and presented an excellent colored photomicrograph of the labyrinth, which shows typical foci of otosclerosis. The deafness in general is manifested by a loss for both the low and the high tones; the Rinne test gives negative results. The upper tone limits are decreased, and while air conduction is greatly impaired, bone conduction usually remains practically normal.

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6. Ruttin, E.: Osteopsathyrose and Otosklerose, Ztschr. f. Hals-, Nasen- u. Ohrenh. **3**:263, 1922.

7. Cleminson, F. J.: Otosclerosis Associated with Blue Sclerotics and Osteogenesis Imperfecta, J. Laryng. & Otol. **42**:168 (March) 1927.

It is stated that among adults with blue scleras, 60 per cent have fragile bones, 60 per cent associated deafness and 44 per cent all three defects. Different figures, however, appear if children are included, for the deafness is a late manifestation.

It is noted that in the 2 cases reported both the nerve and the conduction type of deafness were present. A marked loss for the upper tones was observed, particularly above the frequency of 4096 cycles. The deafness of the brother was characterized by a decrease in the bone conduction, although the Rinne tests were still negative.

SUMMARY

The history and findings of the cases of 2 persons in one family, a brother and sister, having the interesting clinical syndrome of brittle bones, blue scleras and deafness, are presented. The hereditary characteristics of this condition and the features of blue scleras, brittle bones, dislocations and deafness are discussed. The blue scleras and the brittle bones are noticeable early in life; the deafness, which is of the otosclerotic type, usually comes on in the late twenties.

Case Reports

NASOPHARYNGEAL CANCER

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Neoplasms of the upper end of the respiratory tree (the nasal cavities, mouth, pharynx and hypopharynx) are more common than in any other region of the body. This is due undoubtedly to the multiplicity of folding and infolding of the neural tube during embryonal development, the numerous and varied types of bacteria which infest these cavities and the traumatism, chemical, thermal and other, to which this part of the structure is so frequently subjected. Often the diagnosis is not made until metastases have become so extensive that therapeutic measures are hopeless. Report by the pathologist of carcinoma without accurate description of the type is misleading and usually results in the otolaryngologist figuratively "throwing up his hands and quitting." Hopeless as the fight against carcinoma at present seems to be, progress can be made and some lives perhaps prolonged only by accurate determination of the type of cell which is producing the neoplasm, followed by intelligent application of the therapeutic measures at one's disposal to the tumors which experience has taught one are amenable to treatment.

These facts were brought forcibly to me in a recent case which I wish to report. More mistakes could not have been made in regard to one person. The first mistake was his own, perhaps, of being born into a family with a neoplastic history. His race (Chinese) made the application of modern therapeutic measures difficult. The first surgeon who saw him, a dentist, several general practitioners, myself, three pathologists—one of international renown—the radiologist and the stenographer, all erred in varying degrees. The undertaker is the only one to whom no odium can be attached.

REPORT OF A CASE

Clinical History.—A Chinese boy aged 17 came to my office on April 22. His complaints were (1) double vision, (2) pain over the region of the right mastoid, with a purulent discharge from the right ear, (3) swelling over the right side of the neck, (4) nasal obstruction, (5) inability to open his mouth more than ½ inch (1.3 cm.) and (6) marked loss of weight.

Family History.—He was the second child in a family of 3. The oldest, a girl, is married, living and well. A younger brother died one year ago in an automobile accident. The father died one year ago from "carcinoma of the stomach," at the age of 51. The mother, aged 46, is living and well.

Past History.—The patient had had the usual diseases of childhood. Since an attack of measles when he was 5 years of age he had had a "persistent running ear." Otherwise he had been well, except for frequent head colds. He had never been able to breathe freely through the nose.

In August of the previous year he noticed a swelling on the right side of the neck, just below the lobe of the ear, which continued to increase in size. He also

had pain over the region of the right mastoid and the right side of the face. He could not open his mouth widely and had difficulty in chewing. He consulted an otologist in November. A diagnosis of chronic mastoiditis was made. He was admitted to the hospital and operated on on November 29. The surgeon's report read, "The entire cellular portion of the right mastoid process is sclerotic. The lateral sinus is curved downward to the antrum; the cavity of the attic is filled with caseous debris." He was discharged from the hospital on December 8 "still having vague pains over the region of the mastoid and a discharging ear." He reported frequently at the doctor's office on account of these complaints but was assured that "everything was all right" and that he would soon be well. On January 26, two months after the operation, he was again admitted to the hospital with a diagnosis of "neuralgia of the trifacial nerve." A dentist extracted a right lower molar. The patient's pain and discomfort increased. He then began "shopping." The chiropractors, osteopaths, Hawaiian herb doctors, purveyors of "Chinese medicine," several general practitioners, a neurologist, a gynecologist all treated him, "without relief." He then fell into my hands.

Physical Examination.—A pale, poorly nourished Chinese boy, 17 years of age, had paralysis of the right external rectus muscle with an internal squint of about 10 degrees. The conjunctiva was pale, but there were no other abnormal ocular findings. There was marked deformity of the nasal septum, occluding both nasal cavities. The patient was unable to open his mouth more than ½ inch (1.3 cm.). His teeth were in good condition. His tonsils were small and appeared normal. There was an exudate on the posterior pharyngeal wall. There was weakness of the lower branches of the right facial nerve and hypersensitivity of the right side of the face. There was a healed mastoidectomy wound behind the right ear and a foul-smelling purulent discharge from the right middle ear. There was a diffuse, hard, tender mass involving the right side of the neck. The lymph nodes were discrete and could be easily palpated. There was no objective involvement on the left side of the neck. The chest sounds were normal; there were no abdominal masses nor tenderness. The muscles of the extremities were flabby. The Wassermann reaction was negative. Neither albumin nor sugar was noted in the urine. The erythrocyte count was 3,640,000, with 68 per cent hemoglobin, and the leukocyte count 14,700, with 86 per cent polymorphonuclears. Cultures from the middle ear showed Staphylococcus aureus in pure culture. The roentgenologist's report read: "There is a round area in the right mastoid where bone was surgically removed. A moth-eaten appearance just above this point suggests necrotic bone. The left mastoid is clear. The roentgenogram of the sinus shows a cloudy right antrum."

Diagnosis and Treatment.—The picture was that of Gradenigo's syndrome (purulent otitis media, pain over the temporal and the parietal region and paralysis of the sixth nerve on the same side). The cervical adenitis, I thought, was due to the infection extending through the tip of the mastoid, and the nasal obstruction, to the deformed nasal septum. The patient was subjected to a second mastoidectomy. On turning back the skin flap the previous operative wound in the mastoid was found to be filled with granulation tissue. The posterior superior cells had been opened, and an area of the dura the size of a ten cent piece had been exposed. The dura was covered with granulation tissue. Radical mastoidectomy was done. The patient left the hospital after two weeks. The cutaneous wound was healed. The aural canal was still wet. He was able to rotate the eyes in all directions. The squint had entirely disappeared. He was still unable to open his mouth or breathe through his nose.

Twelve days later a resection of the nasal septum was done, with no improvement in the patient's breathing. The right antrum was lavaged. There was no pus. One month after the nasal operation, the posterior pharynx was explored, and a cervical lymph node the size of a walnut was removed from the right posterior cervical chain. The gland was lobulated and encapsulated and shelled out easily. There was no adhesion nor infiltration into surrounding tissue. There was a small amount of adenoid tissue. The posterior ends of the lower turbinates were enlarged, and there was a round, smooth mass on the posterior pharyngeal wall which completely closed the posterior nasal choana.

One pathologist's report on the cervical lymph node read: "The tissue from the lymph node shows much fibrosis, chronic sinusitis, many polymorphs and many large pale lipoid cells. The temporary diagnosis is chronic inflammation, nonspecific, and probably carcinoma or endothelioma." Another pathologist reported "metastatic branchiogenic carcinoma." The stenographer wrote "bronchgenic." The third said: "According to my opinion the condition is transitional cell carcinoma that has originated in the nasopharynx. The point of predilection for this type of tumor is in the region of the fossa of Rosenmüller, about the opening of the eustachian tube. The tumor cells are large, succulent and undifferentiated. The diffuse syncytial appearance of the cellular mass is, I believe, an artefact due to the solution of formaldehyde. These artefacts are likely to occur if solution of formaldehyde is used as a preservative."

In an effort to relieve the distressing inability to breathe through the nose, three weeks later, the posterior ends of the lower turbinates were amputated. On this material the pathologist reported: "The specimen represents the same type of neoplasm as previously found in the cervical lymph nodes, characterized by syncytial areas of large, pale, waxy cells and abundant accumulations of lymphocytes. This rules out endothelioma primary in the lymph node and resolves the diagnosis into carcinoma primary in the nasopharynx and metastatic to the lymph node."

Further study placed this tumor in the classification of anaplastic transitional cell carcinoma, the so-called lymphoepithelioma, highly malignant and highly radiosensitive.

Shortly after this a roentgenogram of the head was made to determine the extent of the destruction.

On the strength of these reports the family was notified that the youth had "cancer" and that his chances for recovery were poor. High voltage roentgen therapy was recommended as a palliative measure. Reluctantly the family acceded to this suggestion. He was given two roentgen treatments over the right side of his neck. The first ones consisted of 225 hour units, with the tube at a distance of 40 cm., filtered with 0.5 mm. of copper and generated at a voltage of 2 kilovolts. Three days later he was given 180 hour units, but because the radiologist would not guarantee a cure the family refused to take him back for further treatment. After a temporary improvement following the last dose of irradiation his condition gradually became worse. On a final admission to the hospital he was unable to swallow. Breathing was entirely through his mouth. The right mandibular joint was completely ankylosed, as were the upper cervical vertebrae. He died twenty-five days later, one year from the time of his first mastoidectomy.

COMMENT

In 1921 Gordon New,[1] in reporting on 79 patients with malignant nasopharyngeal tumors, called attention to the extreme difficulty fre-

1. New, G. B.: Syndrome of Malignant Tumors of the Nasopharynx, J. A. M. A. **79**:10 (July 1) 1922.

quently encountered in making an early diagnosis. Eighteen of the 51 patients who had involvement of the glands of the neck had had operations on the glands without discovering the primary tumor. One patient had had five operations because of recurring involvement of the glands. Twelve had had teeth removed, usually wisdom teeth, because of pain. Practically all of them had been referred because of some other condition than that for which they were finally treated. So, it is not unusual for mistakes in diagnosis to be made with nasopharyngeal tumors, and when a diagnosis of malignant tumor is made the otolaryngologist figuratively "washes his hands of all responsibility." Probably the custom of writing textbooks [2] is somewhat at fault. The modern textbooks of otolaryngology still cling to the old classification of neoplasms—malignant and benign—which is also copied by most modern writers. Of the benign tumors fibromas, lipomas, hemangiomas, papillomas and teratomas are listed, and of the malignant ones there are three, carcinoma, sarcoma and malignant chondroma. The more modern classifications appear in textbooks other than those of otolaryngology or in periodicals to which the average otolaryngologist rarely refers.

It will be recalled that the tonsil, the vault of the pharynx, the nasal passages, the base of the tongue and the nasopharyngeal sinuses are covered in part with a stratified squamous epithelium, the cells of which are delicate, do not produce keratin and show little capacity to hornify. The mucous membrane is often interlaced with lymphoid tissue which has been given the name "lymphoepithelium." Tumors held by some as arising from this type of epithelium present peculiar clinical and histologic characteristics. They are frequently anaplastic and are more related to squamous than to basal cell carcinoma. They do not as a rule produce bulky growth, they early invade bony tissue and the lymph channels which drain the affected area and have a tendency to produce small infiltrating masses which are easily overlooked. The 9 patients on whom Cutler [3] reported in 1929 were between the ages of 40 and 59, but the tumors frequently occur in younger persons, in whom carcinoma is not suspected. Regaud gave the growth the name lymphoendothelioma on account of its anaplastic nature; however, Cutler's designation of epidermoid carcinoma is more descriptive of the real character of the neoplasm, which he divides into two quite definite classes—lymphoepithelioma and transitional cell carcinoma. Lymphoepithelioma is less common than the other. It is recognized by the syncytial cell masses and the rich infiltration with lymphocytes. The cells are large and pale, with a thin cell membrane. The protoplasm is ill defined and trabeculated and often forms a true syncytium. The nuclei are large, clear and pale and show marked variation in size. In a review of 300 tumors at the base of the tongue, only 19 were found to fall into this group (Ewing [4]). The tumor

2. Jackson, C., and Coates, G. M.: The Nose, Throat and Ear and Their Diseases, Philadelphia, W. B. Saunders Company, 1929.

3. Cutler, M.: Radiosensitive Intra-Oral Tumors: A Clinical Study, Arch. Surg. **18**:2303 (June) 1929.

4. Ewing, J.: Neoplastic Diseases, ed. 3, Philadelphia, W. B. Saunders Company, 1928.

reported on here, as will be observed from the photomicrographs made from sections of both the turbinate tumor and the lymph node metastasis, falls into the classification of lymphoepithelioma. Transitional cell carcinomas are more common; Cutler [3] said:

> The structure to which this term has been applied shows mainly small round and polyhedral cells with relatively large hyperchromatic nuclei which occupy almost the entire cell. The cells vary markedly in size and staining intensity, and mitoses are abundant. The cells grow diffusely in cords and sheets and infiltrate the surrounding lymphoid tissue. The arrangement is sometimes plexiform. Polymorphonuclear leukocytes, lymphocytes and plasma cells are numerous. The cells show marked loss of differentiation and squamous characters are entirely lacking. These tumors sometimes reach a high grade of anaplasia.

Tumors of this type are frequently found in other parts of the body, particularly in the esophagus and the cervix. Of 200 carcinomas of the cervix studied 20 per cent presented features of this group of neoplasms.[5]

TREATMENT

Tumors of this type are also the ones from which radiologists and cancer specialists pile up testimonials. Their anaplastic nature makes them outstandingly sensitive to roentgen rays and radium. This observation was made by Regaud many years ago in treating neoplasms which had involved lymph glands. Jovin [6] in 1926, in describing the clinical and pathologic features of these tumors, called particular attention to their high degree of malignancy and their marked susceptibility to radiation. Cutler in 1929 reported 9 patients treated with roentgen rays and radium combined, with cures lasting from three to twelve years. Crowe and Baylor [7] noted outstanding results in the radium treatment of certain growths in the nasopharynx. Surgical intervention, of course, is not to be considered, because of the difficulty in isolating the primary focus and the early widespread metastasis to surrounding lymph glands and bone. Diathermy or electrocoagulation are likewise of no avail.

SUMMARY

A case of lymphoepithelioma is reported in which many mistakes were made before an accurate diagnosis was arrived at. The necessity for accurate description of neoplasms of the nasopharynx by the pathologist is stressed and otolaryngologists reminded that enlargement of cervical glands is not always "inflammatory."

5. Healey, W. P., and Cutler, M.: Relation Between Structure and Prognosis in Cervical Carcinoma Under Radiation Treatment, Am. J. Obst. **16**:15, 1918.

6. Jovin, J.: Les lympho-épithéliomes du pharynx, Ann. d. mal. de l'oreille, du larynx **45**:729, 1926.

7. Crowe, S. J., and Baylor, J. W.: Benign and Malignant Growths of the Nasopharynx and Their Treatment with Radium, Arch. Surg. **6**:429 (March) 1923.

FOREIGN BODIES IN THE EUSTACHIAN TUBE

A. MANGIARACINA, M.D., BROOKLYN

Perusal of the literature reveals but a single case of removal of a foreign body from the eustachian tube. Hastings [1] removed a piece of gold bougie from the distal half of the eustachian tube during a radical mastoidectomy.

If a foreign body is lodged at a distance from the outer end of the tube it cannot be removed through the ear. The only available path is through the pharyngeal opening.

The entire length of the auditory tube is about 40 mm., and its smallest diameter at one point is less than 3 mm. To remove a foreign body an instrument must slide into the tube for at least 25 mm. if necessary (to the junction of the membranous and the bony canal) and have a diameter of less than 3 mm. It must also be surmounted with a grasping forceps.

Fig. 1.—Twisted wire removed from the eustachian tube.

The case here reported gave me the opportunity to use such an instrument, which I shall describe in detail.

REPORT OF A CASE

J. S., a man aged 51 years, reported to Dr. Herbert's clinic at the Brooklyn Eye and Ear Hospital on March 16, 1938, with a history of tinnitus in both ears of several years' duration. Examination disclosed a bilateral otitis media catarrhalis chronica, associated with thickened and retracted drums, a deviated septum on the left side and a septal perforation resulting from a previous submucous operation. The nasopharynx and throat were normal. The Wassermann test and urinalysis gave negative results. The blood pressure was 165 systolic and 95 diastolic. There was loss of hearing in both ears, a 31 per cent loss in the right and 38 per cent in the left.

Read before the Ear, Nose and Throat Section of the Kings County Medical Society, Jan. 10, 1940.

1. Hastings, H.: A Piece of Gold Bougie (Twenty Years in Situ) Removed from Distal Half of the Eustachian Tube During a Radical Mastoid Operation, Ann. Otol., Rhin. & Laryng. **46**:248 (March) 1937.

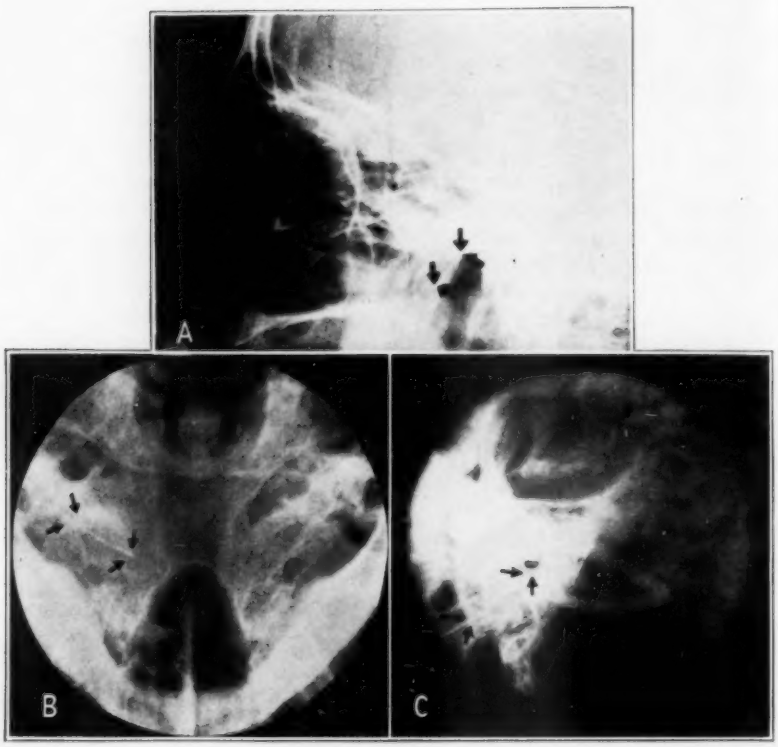


Fig. 2.—The wire in the eustachian tube. *A* shows the lateral view of the foreign body and *B* the petrous position. *C* shows a stereoscopic view of the foreign body.

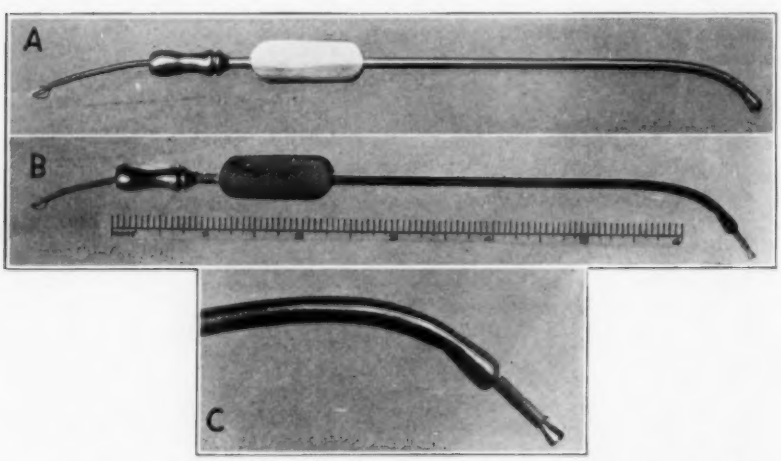


Fig. 3.—The instrument used in removal, through the nostril, of the foreign body lodged in the eustachian tube. *A* shows the instrument closed; *B* shows the jaws of the forceps open and the inner cannula projecting out of the outer cannula, while *C* is an enlargement of the distal end of *B*.

The patient was treated with applications of 25 per cent ichthammol in glycerin to the eustachian tubes at frequent intervals. These treatments were continued until Oct. 20, 1939, because the patient felt that they lessened the tinnitus. On that date a twisted wire applicator used in making the applications broke within the canal in three pieces, two short pieces and a long one, all held together by the tightly wound cotton used. The total length of the three pieces was 40 mm.

Roentgen examination disclosed that the wire occupied almost the entire length of the eustachian tube.

On October 23, the patient began to complain of fulness in the left ear. The left ear drum was congested. The aural symptoms became gradually worse, and on November 6 the ear began to discharge.

On November 14 a nasopharyngoscope was introduced into the right nostril and held in place by an assistant. Under direct vision the closed cannula was introduced into the left nostril and hooked into the opening of the eustachian tube; the inner flexible cannula was slid into the tube for a distance of 15 mm.; the jaws of the forceps were closed by pulling the wire inside the flexible tube, and the instrument with the foreign body was brought out through the nostril.

On November 20 the ear drum had healed completely.

The instrument consists of:

1. An outer cannula 16 cm. long and with an inner diameter of 2.5 mm. It is curved like a eustachian catheter. (A no. 4 eustachian catheter may be used.)

2. An inner flexible tube made of no. 4 steel snare wire. It is 19 cm. long and has an inner diameter of 1.5 mm.

3. Grasping forceps 2.5 mm. wide and tapering to 1 mm. They are 15 mm. long and are made from a piece of watch spring bent double.

4. A piece of steel wire, looped at the base of the forceps and twisted. This wire runs through the inner tube; it is 20 cm. long.

When the wire is pulled the forceps slide more deeply into the inner flexible tube, closing the jaws. When the instrument is closed only the edge of the forceps appears at the point of the cannula.

Clinical Notes; New Instruments and Technics

CARE OF WOUNDS MADE IN RADICAL AND IN MODIFIED RADICAL MASTOIDECTOMY

HANS LION, M.D., CINCINNATI

A well known otolaryngologist once said, "The radical mastoid operation is a difficult one, but its after-treatment is even more difficult." One knows from experience that he meant: (1) the adequate control of the granulation process in the cavity, (2) the utmost care in order to accelerate and complete the epidermization process and (3) the avoidance both of adhesions and of formation of separated cavities. When there is a lack of epidermization due to a retardation of the epithelial production in certain parts of the cavity, the patient often has trouble for a lifetime. It is not the purpose of this article to describe all the methods which have been used to manipulate the healing process, but I should like to report a method which I have used in 43 cases, which has given me excellent success for many years.

Before an attempt is made to carry out my treatment, it is presumed that the slightest particle of diseased bone, cholesteatoma and granulation tissue has been removed meticulously and that the operator did not leave diseased bone cells behind bone structure which seemed clean and healthy and appeared to be the outer wall of the mastoidectomy cavity. It is furthermore presumed that the facial ridge has been properly lowered.

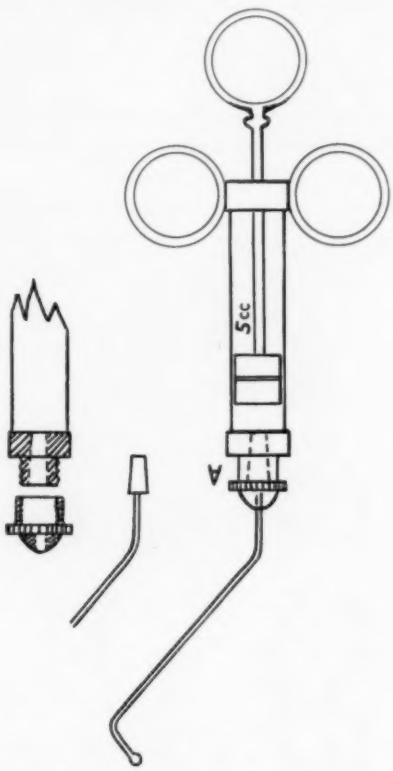
After removal of the primary dressing on the fifth day following the operation or earlier, if necessary, the radical mastoidectomy cavity is washed with sterile saline solution at body temperature. For the primary dressing a Mikulicz tampon is used, the outer layer of which is soaked in sterile petrolatum. This tampon is removed with hydrogen peroxide, pain being reduced thereby and damage to granulation tissue minimized.

From then on, scarlet red (amidoazotoluyl) ointment is used in a special way. It is pressed into the cavity with an ointment syringe, which I have designed for this purpose, first into all the indentations of the mastoidectomy cavity, such as the middle ear cavity with its tympanic end of the eustachian tube, the antrum, the part behind the facial ridge and the lower part of the mastoid process. After the ointment has been thoroughly pressed into the indentations, the entire cavity has to be filled with scarlet red ointment, which now covers the walls under pressure.

The tip attached to the syringe is curved and the outer end enlarged, and by the loosening of screw *A* the instrument can be adjusted in any direction so that it reaches into the indentations just named.

It is understood that in pressing the ointment into all the corners it is advisable not to touch the walls, in order to avoid both pain and interference with growth of granulation tissue. The syringe is filled with scarlet red ointment by taking out the piston and pressing the ointment in the syringe from the tube. The piston is then inserted, and the air in the tip of the syringe is pushed out.

This procedure has to be repeated, at first every day and later every second or third day, according to the healing. Each time the cavity has to be rinsed *thoroughly* with sterile water of body temperature and cleaned. The granulation area should be treated as delicately as the tender roots of a plant. The cavity must, if necessary, be dried with warm air or sterile cotton. Then the whole cavity has to be filled again completely with scarlet red ointment and closed gently with a small pack of sterile cotton. *No tampon or gauze should be applied within the cavity.*



Syringe for inserting ointment into mastoidectomy cavity.

Soon there is a rapid growth of epithelium. The overgrowth of granulation tissue, especially in the neighborhood of the antrum, has to be retarded by cauterization with a silver nitrate stick or with solution of different percentages, according to the kind of granulating tissue. After two or three weeks, owing to the scarlet red ointment, such a quick and enormous growth of epithelium can be observed that cone-shaped excrescence can often be seen on the epithelium surface.

If the whole surface is almost covered with epithelium the application of scarlet red ointment should be discontinued.

With this method, epithelization of the cavity in 43 cases has been complete after several weeks. The opening of the eustachian tube was either closed by formation of an epithelial layer over the opening or by extension of epithelium into the tube and probably occlusion in its depth.

In no case did any other method of closing the eustachian tube have to be used. It is always necessary to clean the cavity from time to time, removing accumulations of wax and cerumen.

426 Doctors Building.

NASOPHARYNGEAL ATRESIA

Description of an Operation

HENRY M. GOODYEAR, M.D., CINCINNATI

A year ago I reported on a method of treating nasopharyngeal atresia,[1] stating that it gave an excellent result when the tissues were not so scarred but that they

Rubber catheter in place.

could be slightly depressed by passing a no. 4 frontal sinus dilator through the nose before incising the pharynx in a horizontal direction.

From the Otolaryngological Department, the University of Cincinnati College of Medicine.

1. Goodyear, H. M.: Nasopharyngeal Atresia: Description of an Operation, Arch. Otolaryng. **29**:974-976 (June) 1939.

Ten months ago I examined a woman, aged 24 years, who had had complete nasopharyngeal atresia for twelve years as the result of syphilis. In this case the pharyngeal tissues were a mass of hard scar tissue, which could not be moved or indented by passing a nasofrontal sound through the nose.

A horizontal incision opening into the nasopharynx was made in the scar tissue. In order to maintain this opening until new membrane could grow over the freshly cut edges of the incision, a rubber catheter was passed through the nose and into the pharynx. The end of the tube in the pharynx was then brought back through the posterior nasal opening on the opposite side. The tube was cut at such a length that a loop of the catheter extended below the opening in the pharynx, as shown in the figure. The two ends of the catheter were wrapped together with silk thread at the external nares, a process likewise illustrated by the accompanying figure.

The patient was instructed to grasp the protruding ends of the catheter several times each day and pull forward as far as possible, thus bringing the posterior loop firmly against the posterior edge of the nasal septum. The tubing was then to be immediately pushed back, so as to let the pharyngeal loop pass through the nasopharyngeal opening into the pharynx. This movement of the tubing back and forth a number of times each day prevented adhesions until healing occurred over the edges of the new opening into the nasopharynx. A satisfactory opening was obtained, and the patient stated that the fulness and noises in the ears had been greatly relieved.

I feel that the tube should be worn from four to six weeks, or longer if necessary, to insure sufficient healing to prevent the edges of the wound from adhering to the posterior pharyngeal wall.

A no. 16 French catheter is not so large but that it can be worn comfortably in a nose of average size for a long time. At the same time it is sufficiently heavy to form a good resilient loop and does not buckle when moved back and forth in the nose.

556 Doctors Building.

A FORCEPS FOR REMOVING ANTRAL MUCOSA FOR BIOPSY

ROBERT HENNER, M.D., AND MARTIN URIST, M.D., CHICAGO

The purpose of this communication is to present an instrument which has been successfully used in over 300 cases in the past three years for the removal of antral mucosa for diagnostic purposes. This instrument was devised in order that it might aid in the study of the serial changes of sinus mucosa cytologically and thus help in determining indications for types of therapy. It will prove valuable particularly now that Firor and Waters[1] have shown that roentgen therapy can be valuable in those particular cases of subacute sinusitis in which there is a dense

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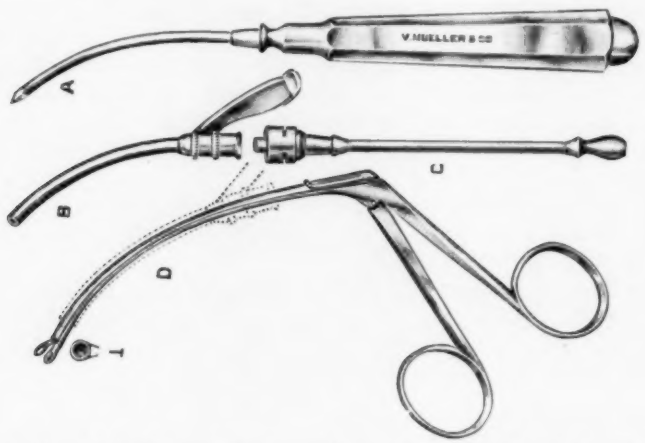
From the Illinois Eye and Ear Infirmary.

1. Firor, W. B., and Waters, C. A.: The Present Status of Roentgen Treatment of Sinus Infections, Am. J. Roentgenol. **42**:857-865 (Dec.) 1939.

infiltration of lymphocytes rather than fibrotic thickening. A complete résumé of our work will be presented subsequently.

The instrument consists of an ordinary Coakley antrum trocar (*A* and *B*) with a slightly larger bore, a Hartmann ear forceps modified with a curved and elongated shank (*D*) and a washing attachment (*C*). After perforation of the inferior meatus, the antrum is irrigated and the forceps passed through the trocar handle (*B*) into the antrum. The instrument is so constructed that purchase is obtained on the shank of the forceps (*D*) by the close approximation of the trocar. With practice the instrument can be manipulated so that from any wall but the inferior medial wall and the medial wall material can be taken for biopsy. About a square millimeter of tissue in cases of normal mucosa and larger pieces in cases of severely thickened mucosa may be removed. The actual size of the cup for the biopsy specimen is indicated by the inverted T. In cases of disease diagnosed by examination of tissue removed at a Caldwell-Luc operation, an accurate correlation in histologic interpretation has been observed.



Drawing of the forceps for removing antral material for diagnosis.

We have found the instrument valuable in checking the roentgenographic picture of sinusitis pathologically and as a guide for surgical and roentgen treatment. In addition to those uses in cases of inflammatory conditions, it has also been used as an aid in the diagnosis of malignant growths, obviating the necessity of a Caldwell-Luc operation for this purpose.

PREVENTION AND CORRECTION OF DORSAL DEPRESSIONS BY SEPTAL IMPLANTS

IRVING B. GOLDMAN, M.D., NEW YORK

The purpose of this communication is to acquaint the rhinologist, who is constantly called on to perform submucous resection for nasal obstruction, with a

From the Nose and Throat Service of the Mount Sinai Hospital.

simple procedure for correction of nasal depressions involving the cartilaginous dorsum. This is accomplished at the same time as the septum is being corrected, by reimplantation of the removed cartilaginous fragments.

The depression deformity may have resulted from trauma and may be accompanied by a deviated septum. Under such conditions correction by a partial submucous resection is unsatisfactory, whereas a complete submucous resection may

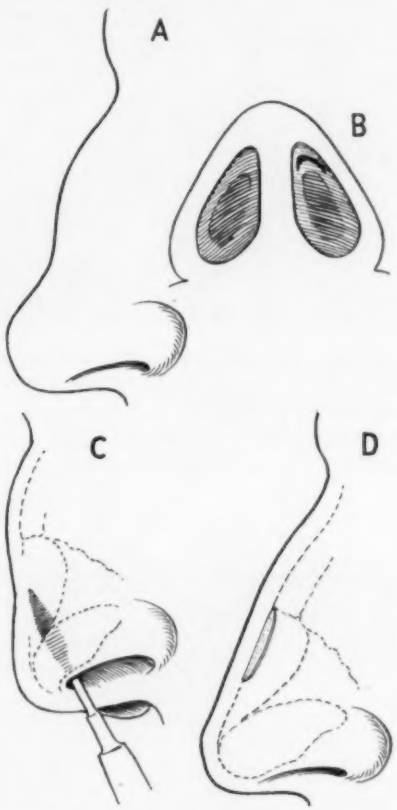


Fig. 1.—Procedure for correction of nasal depressions involving the cartilaginous dorsum. *A*, the usual type of depression of the cartilaginous vault; *B*, marginal incision in the rim of the wing cartilage; *C*, preparation of the pocket by the undermining of the subcutaneous tissue, and *D*, the implant in position at the side of the depression and the resultant elevation of the dorsum.

be followed by an accentuation in the saddle appearance. The operator is often criticized for not having left sufficient cartilage to support the dorsum, and a rhinoplastic procedure will eventually become necessary to correct the deficiency of the framework. Not only can the increased saddle be prevented, but it can be

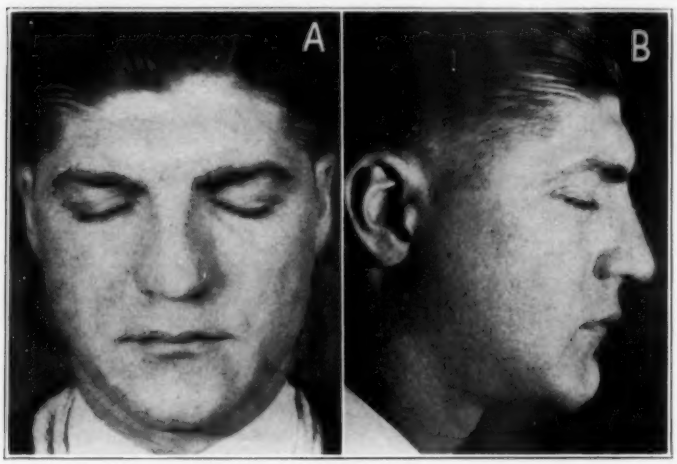


Fig. 2.—Result of operation to correct a saddle nose caused by trauma received in boxing. Marked nasal obstruction necessitated submucous resection, which left the depression appreciably increased. The septal cartilage was inserted through an incision in the right upper lateral cartilage. An excellent dorsum and profile were obtained in addition to a good functional result.

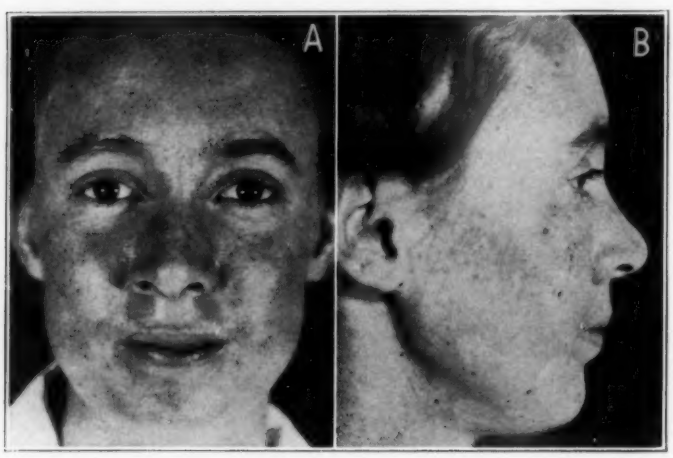


Fig. 3.—End result obtained by similar procedure used for a nurse who had a depressed dorsum and a deviated septum.

Fig. 4.—*A*, depression of the dorsum after a submucous resection. *B*, correction of the depression at a later date, accomplished by a rhinoplastic procedure consisting of freeing, elevating and overlapping of the upper lateral cartilages to elevate the dorsum sufficiently.

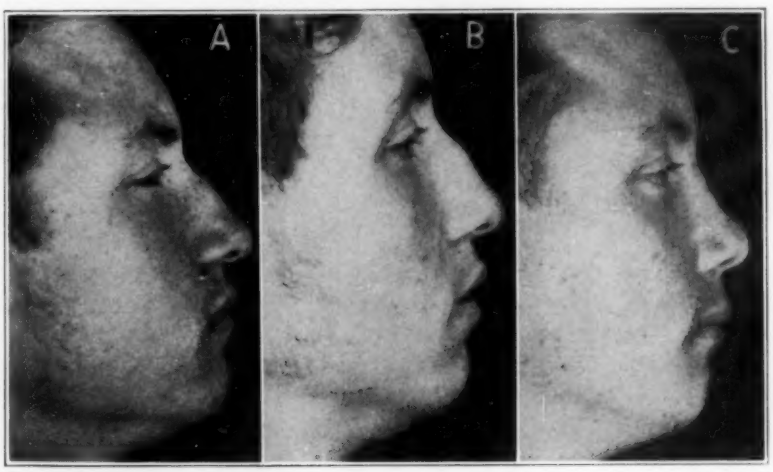


Fig. 5.—Increased depression of the dorsum following submucous resection performed on a boy of 17 years, and subsequent correction of the depression by a rhinoplastic procedure, consisting of removing the bony hump and sliding it into the depression, where it elevated the dorsum. *A*, before submucous resection; *B*, after submucous resection, and *C*, after rhinoplastic operation.

corrected at the time of the submucous resection by the insertion of cartilage immediately into the dorsum through an incision in the wing cartilages.

PROCEDURE

The submucous resection is done in the usual manner. The removed septal cartilage is kept in a saline solution. The dorsum is then infiltrated intranasally with a 1 per cent solution of procaine hydrochloride containing epinephrine. Through a marginal incision in the upper lateral cartilage, the dorsum is undermined at the site of the depression. By elevation of the subcutaneous tissue a pocket is prepared for the reception of the transplant. The cartilaginous graft,

Fig. 6.—Roentgenogram of the nose illustrated in figure 5; taken after the rhinoplastic operation, it shows in the new position elevating the saddle the bone which had been removed from the hump. The fracture along the nasal process of the maxilla is also seen.

which is properly shaped so that it will fit the area, is inserted then into the desired position. The incision is closed with one fine black silk suture. The graft is held in position by a piece of adhesive tape applied on the dorsum, which can be removed in forty-eight hours. Hardly any reaction follows. The nose is packed as usual for a submucous resection.

CONCLUSION

The results have been most gratifying. I believe that this procedure should be in the armamentarium of the rhinologist who performs submucous resections. It is of particular value to the rhinologist who finds it necessary to remove a good deal of septum and is helpless when the saddle becomes apparent. In the training of resident surgeons who are prone to remove too much septum, this

method has been used effectively. It is of paramount value in those cases in which preexisting cartilaginous depressions are present. Persons who obtain relief for nasal obstruction by submucous resection simultaneously attain esthetic satisfaction.

DEVICE TO HOLD DIAGNOSTIC TUBE IN PLACE

J. C. Anderson, M.D., Pittsburgh

Retaining the ear piece, or tip, of the diagnostic tube in the physician's ear during examination or treatment of the eustachian tube has always been somewhat difficult, as well as awkward. In an effort to overcome this difficulty, I have devised a rather unusual apparatus.

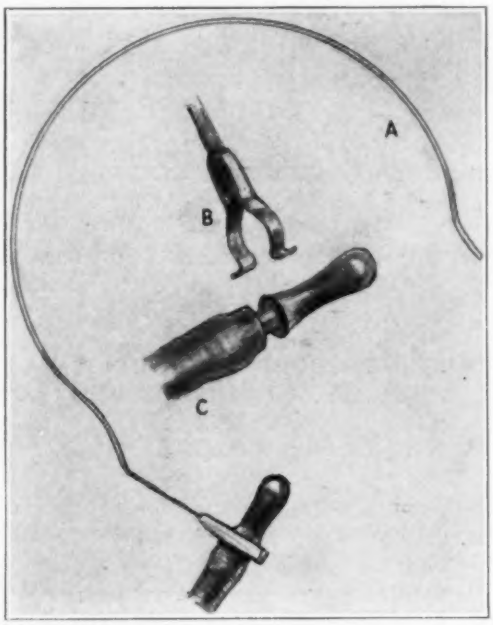


Fig. 1.—Drawing of the apparatus to hold the diagnostic tube in place; *A*, the whole device, showing the ear piece of the tube held by the fitting on the steel headband; *B*, detailed illustration of the fitting on the headband, which grasps the ear piece, *C*.

It consists of a light, narrow, sturdy band of spring steel which fits over the vault of the physician's head, in somewhat the same manner as the headband used by some hearing aid sets. This band has a fitting which slips over the base of the ear piece of the diagnostic tube. Since the ear piece is held in position by

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From the Oto-Laryngology Service of the Columbia Hospital.

the headband, the physician is permitted the free use of both hands at all times during the examination or treatment of the eustachian tube.

The accompanying illustrations show the appearance of the instrument together with the materials used in its manufacture.

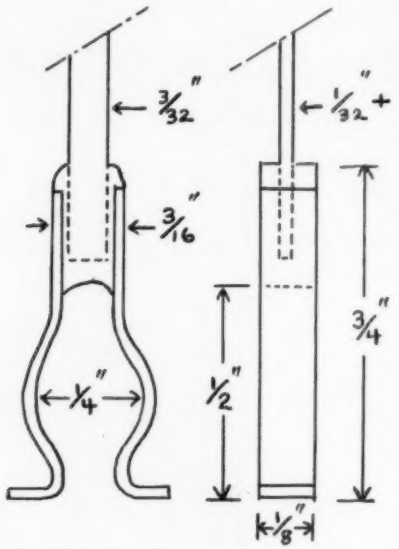

Fig. 2.—Diagram showing the measurements of the materials composing the apparatus.

A NEW BRONCHOSCOPE FOR EXAMINATION OF THE BRONCHI TO THE UPPER LOBES

KARL GRUPPE, M.D., UTICA, N. Y.

The often present desire actually to look upward into the bronchi to the upper lobes was brought to a focus recently by the appearance of a patient with an

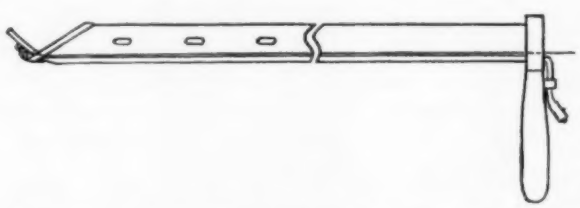

Diagram of the new bronchoscope, showing the small mirror attached to the lip end.

obscure pathologic condition in the upper lobe of the right lung. The idea of fixing a mirror to the end of a bronchoscope came to mind. A review of the recent catalogs of instruments revealed no listing of such an instrument. One was

devised, therefore, by attaching a small postnasal mirror to the lip end of a 9 mm. bronchoscope. The mirror was hinged to the instrument with a small double hinge from a pair of spectacles. The angle of the mirror was rendered controllable by the application of a push rod extending the length of the bronchoscope in the groove made by the light carrier, as shown in the diagram.

The use of the instrument is as a rule preceded by a routine examination by means of the usual bronchoscope, all examinations other than that of the upper lobes being made before the introduction of the special instrument. When the mirror bronchoscope is used, the mirror is placed in an outward position so as to permit a forward view of the trachea. It is introduced by means of the direct laryngoscope and passed onward into the main bronchus. The push rod is then withdrawn to adjust the angle on the mirror, and by means of manipulating the angle and shifting the position of the bronchoscope the upper lobe bronchus may be visualized.

The instrument thus far has been used in only a few cases, but in each case the upper lobe bronchus has been definitely visible. The problem of fogging and clouding by secretions seems to be readily coped with. Pus and mucus are removable from the mirror by use of the suction tip and, if necessary, by the application of a sponge carrier, so that a reasonable view may be obtained. As to fogging, it has not been found necessary to heat the mirror before introducing it. It promptly warms up and is clear, at least during the inspiratory phase.

So far the instrument has not been employed in conjunction with instrumentation on an upper lobe, but there is no reason why this method of examination should not aid in that procedure, except, of course, that the forceps or aspirating tube being used might interfere with the vision.

At present this instrument is not available for purchase but is being submitted for manufacture.

258 Genesee Street.

Progress in Otolaryngology

Summaries of the Bibliographic Material Available in the Field of Otolaryngology

THE PARANASAL SINUSES

SAMUEL SALINGER, M.D.
CHICAGO

(Concluded from page 375)

MALIGNANT TUMORS

A statistical review of 249 cases of malignant tumor of the head or neck is presented by Fabricant.[108] This material covers a period of seven years at the Research and Educational Hospital, in Chicago, where the yearly admissions to the nose and throat clinic average about 2,500. In this series there were 7 cases of malignant tumor of the antrum and 1 case of malignant tumor of the frontal sinus, certainly a small number in proportion to the total.

Schall [109] stresses the importance of being on the lookout for possible carcinoma in all persons coming for examination of ears, nose or throat, since it is easy to overlook this neoplasm in the early stages. He states that in New England the Barnes influence is still felt in the matter of surgical treatment, the Barnes incision (a modification of Langenbeck's) being still widely employed. The author has discarded this approach because of the large defect it leaves and prefers a modification of the Moure incision, splitting the lip and laying the entire cheek back so as to afford a wider exposure. He removes the growth with forceps and curet and follows up with the desiccating electric current. Radium is placed within the cavity for a total of 2,000 to 4,000 milligram hours. The author noted postoperative exophthalmos in 5 cases, a complication which may necessitate enucleation.

Bremond [110] insists that there is no such thing as primary carcinoma of the superior maxilla, because any malignant tumor arising in this bone, which has no epithelial cells, must be sarcoma. Epithelioma arising from a dental follicle is not, strictly speaking, a neoplasm of the superior

108. Fabricant, N. D.: Incidence of Malignant Tumors of the Head and Neck, Arch. Otolaryng. **29**:65 (Jan.) 1939.

109. Schall, L. A.: Diagnosis and Treatment of Malignant Diseases of the Nose and Nasal Sinuses, J. M. Soc. New Jersey **36**:78 (Feb.) 1939.

110. Bremond, M.: A propos du cancer dit "du maxillaire supérieur," Marseille-méd. **76**:11 (July 5) 1939.

maxilla but rather a neoplasm of the dental apparatus. Otherwise, carcinoma of the upper jaw originates from the mucosa of the cavities in or adjacent to the maxillary bone, which may become involved secondarily. The author likes Sibeleau's classification: (1) a growth, neoplastic or tumoral, tending to invade the nasal fossa, canine fossa, buccal cavity, orbital cavity or pterygopalatine space; (2) a suppurative form superimposed on chronic suppurative sinusitis, and (3) a gangrenous form, resembling necrosing osteoperiostitis. Among the symptoms suggesting extension of the growth beyond the limits of the sinus he mentions (1) a sensation of weight in the face, (2) a feeling as if the teeth were being stretched, (3) pain or neuralgia and (4) asymmetry of the face. A condition is no longer operable (1) when adenopathy is present, (2) when the zygoma is involved, (3) when the pterygopalatine space is invaded and (4) when the orbital-lacrimal area is involved.

Weinberger [111] believes from a study of the literature that more emphasis should be placed on proper irradiation of neoplasms regardless of the histologic type. (Naturally, this would apply only to the inoperable ones, since the reports from the best clinics indicate that the best results with operable tumors are obtained by combined surgical removal, diathermy and irradiation. S.S.) Several illustrative cases are cited, including one of advanced carcinoma of the antrum and frontal sinus in which a primary regression was followed by a fatal termination six months later, probably from cerebral extension.

Szolcsanyi,[112] while admitting the superiority of combined surgical removal, diathermy and irradiation for carcinoma of the antrum, nevertheless reports a case in which the growth was successfully treated by roentgen rays alone. The growth involved the antrum and extended through the anterior wall into the nose and back to the choanae. It was considered inoperable and was treated by the protracted fractional method as modified by Lenart; twenty treatments were given over a period of twenty-three days, and one month later ten treatments were added, making a total of 5,700 roentgens (r) (measured in air) through four portals. A follow-up roentgen examination six months later showed complete regression of the tumor and a normal-appearing sinus.

Phelps [113] reports a case in which swelling of the upper jaw was treated by extraction of several teeth. Some tissue attached to the roots was adamantinoma, and there was invasion of the bone (an unusual finding). Later the patient complained of a throbbing sensation in the

111. Weinberger, N. S.: Malignant Tumors of the Nasopharynx and Paranasal Sinuses, Tr. Am. Laryng., Rhin. & Otol. Soc. **45**:221, 1939.

112. Szolcsanyi, J.: Roentgenotherapy of Carcinoma of the Maxillary Sinus, Orvosi hetil. **83**:787 (Aug. 12) 1939.

113. Phelps, K. A.: A Case of Malignant Adamantinoma of the Right Maxillary Sinus, Tr. Am. Laryng., Rhin. & Otol. Soc. **45**:393, 1939.

upper jaw, extending to the frontal and occipital regions, and of numbness and swelling of the hard palate and cheek. Roentgen pictures revealed a tumor of the antrum with destruction of the bony walls. The operation which followed consisted in ligation of the external carotid artery and removal of the mass through the palate. The orbital floor was found intact. Six months later a mass was found in the soft palate, extending to the lateral wall of the pharynx. The histologic diagnosis was malignant adamantinoma. Radium seeds were planted in the mass, without effect. One month later the growth recurred in the nose, upper sinuses and orbit, with fatal ending. Autopsy revealed metastases to the liver, lungs, pleura and retina.

Petterino-Patriarca [114] reports 4 cases of extensive malignant tumor of the upper jaw treated electrosurgically. He lists the advantages of this procedure as follows: (1) It can be employed under local anesthesia; (2) the absence of hemorrhage facilitates the operative procedure; (3) there is no operative shock; (4) there is no postoperative hemorrhage, and (5) radical extirpation is possible. Illustrations accompanying the article show extensive resection through the maxilloorbital angle and palate. The author did not find it necessary to ligate the carotid artery in any of the cases. Two of the 4 patients were without recurrence and well two years after operation; the other two showed excellent primary results, but these were too recent for the patients to be considered cured.

Three authors from widely separated centers report cases of melanoma of the sinuses. Smith,[115] who reports 2 cases, states that he was able to find only 12 similar cases in the literature. One of his patients was a woman of 60, whose complaint was recurring epistaxis. A small red soft wartlike mass was seen growing from the floor of the left nasal fossa. It was snared off and was found to be a very cellular structure with little stroma but a large amount of pigment. Sixteen months later a nodule appeared in the left submaxillary region, growing slowly. Histologic examination revealed a highly cellular mass with little stroma and no pigment. It was believed to be carcinoma. After operation the region was irradiated, and the patient remained free from symptoms for two years. Then deafness, tinnitus, diplopia and vertigo appeared, suggesting cerebral metastases. Autopsy confirmed the diagnosis, and sections from the brain revealed tumor tissue similar to the previously removed growths, including a large amount of pigment.

The second patient, a man of 35, was operated on for removal of a granular mass from the anterior end of the inferior turbinate, which was

114. Petterino-Patriarca, A.: Il trattamento elettrochirurgico dei tumori maligni del massiccio facciale, Oto-rino-laring. ital. **8**:429 (Nov.) 1938.

115. Smith, A. T.: Primary Melanoma of the Nasal Cavity, Arch. Otolaryng. **29**:437 (March) 1939.

causing nasal obstruction. The lesion was diagnosed as granuloma. Sixteen months later the tumor recurred and on removal was diagnosed as carcinoma. Soon after, it was necessary to operate on the antrum, which was found to be invaded. Histologic study of the tissue removed revealed melanoma. Multiple metastases developed rapidly, with a fatal result. Autopsy revealed over 300 separate nodules scattered throughout the body. The author points out that such lesions involving the mucosa do not always contain pigment, which may make the diagnosis difficult. Other characteristics of the tumor are masses of round or polyhedral cells with little or no stroma, numerous blood vessels and no apparent connection between the cell groups and the overlying mucosa.

Diggle's patient,[116] a man of 69, complained of intermittent epistaxis. A red fleshy mass was found filling the nasal cavity and bleeding readily when touched. Roentgen films revealed cloudiness of the antrum and of the ethmoid and frontal sinuses. The excised tissue was described as a "pigment-producing tumor composed of round cells lying loose in vascular connective tissue." Lateral rhinotomy was performed, and the tumor was found invading the antrum and ethmoid cells. Postoperative irradiation was ineffective, and the patient succumbed ten months later. The author, commenting on the rarity of the tumor, states that only 1 example was seen at the Christie Hospital and Holt Radium Institute, in Manchester, England, in a period of six years, among a total of 176 malignant tumors of the sinuses. He believes that in the case reported the origin of the tumor was in the olfactory region, the pigment cells coming from similar cells usually found in the olfactory mucosa.

Mayoux and Perron [117] were able to find reports of 38 cases of melanoma of the sinuses in the literature. They express surprise that some authors still consider this tumor a connective tissue growth whereas in fact it is of epithelial origin. In 42 per cent of the 38 cases the neoplasm affected the nose and sinuses, and in 47 per cent, the buccal cavity. The authors discount the theory that melanoma is engrafted on the nevus, because it is known that nevi are not present in the nasal mucosa and that there are not any pigment cells there. Although the early symptoms are not characteristic, one should be suspicious of recurring bleeding polypi, particularly if their color is dark, and of granuloma appearing on the inferior turbinate or in the inferior meatus, a site of predilection. Adenopathy is a late symptom. Radium and roentgen rays are ineffective, and the only hope of cure lies in early wide excision plus electrocoagulation.

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116. Diggle, F. H.: Melanoma of the Ethmoid, J. Laryng. & Otol. **54**:254 (May) 1939.

117. Mayoux, R., and Perron, R.: Les tumeurs mélaniques du nez, Rev. de laryng. **60**:245 (March) 1939.

Among 6 cases of cylindroma reported by Kramer and Som [118] there was one in which it involved the antrum. A 23 year old woman complaining of nasal block and pains in the teeth had a roentgenogram with a shadow above the first molar tooth, which was thought to represent a cyst. Extraction of the tooth failed to bring relief, and an exploratory operation on the antrum yielded no additional data. A few months later, in the right nostril a mass was noted, which was very vascular. Also there was a firm nodular swelling in the region of the scar on the alveolus, the hard palate felt nodular and prominent, and the cervical glands were enlarged. A biopsy of the nasal mass was reported as showing adenocarcinoma. Roentgen ray and radium treatment produced temporary recession, and then the growth continued to extend posteriorly. A second biopsy revealed typical cylindroma. A few months later the Caldwell-Luc operation was done, and an encapsulated mass was found adherent to the molar region, extending into the pterygomaxillary space and anterior face of the orbital aspect and the floor of the antrum. It was removed by excision and surgical diathermy. After a symptomless period of three years a recurrence was observed in the hard palate and posterior wall of the pharynx, which yielded to irradiation but was followed by a second recurrence. (A prolonged course with repeated local recurrences is characteristic of cylindroma, metastases being very rare. S. S.)

Santa Cecilia and Elejalde [119] report a case of meningioma omniformis (acute inflammatory), according to the classification of Globus.[120] The patient was a girl of 18, whose only previous illness had been a griplike infection occurring six months earlier, which was followed by a profuse nasal discharge. Then she noted bilateral exophthalmos, failing vision and the appearance of rapidly growing masses in the frontal region, at the root of the nose and in the orbits. A fistula appeared in each lacrimal region, discharging pus. Roentgenograms revealed considerable destruction of bone. The spinal fluid showed 290 cells, mostly polymorphonuclears, a positive Pandy reaction and pneumococci. Autopsy disclosed extensive masses at the base of the brain, mostly in the anterior and middle fossae, with destruction of dura and erosion of the bones of the skull and face. The photographs and histologic slides reproduced in the article are instructive and illuminating.

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118. Kramer, R., and Som, M. L.: Cylindroma of the Upper Air Passages, Arch. Otolaryng. **29**:356 (Feb.) 1939.

119. Santa Cecilia, J., and Elejalde, P.: Meningioma da região fronto-orbitaria, Ophtalmos **1**:9, 1939.

120. Globus, J. H.: Meningiomas: Their Origin, Divergence in Structure and Relationship to Contiguous Tissues in Light of Phylogenesis and Ontogenesis of Meninges, Arch. Neurol. & Psychiat. **38**:668 (Oct.) 1937.

Link [121] describes a case of carcinoma of the ethmo-orbital region in which a diagnosis was made only at autopsy despite roentgen examination and exploratory operation. A man of 36, after complaining of headaches and nasal obstruction for eighteen months, began to have signs and symptoms of orbital involvement, such as impaired vision, impaired mobility of the bulb, slight exophthalmos, paresis of the superior rectus and inferior oblique muscles, choked disk and retinal hemorrhages. Because of nasal polypi and a cloudy antrum, the latter was opened and some diseased mucosa removed. At autopsy the cause of the trouble was found to be a malignant tumor arising from the posterior ethmoid cells, invading the orbit, surrounding the optic nerve and eroding the orbital roof. Its structure was of the undifferentiated type. The author admits that his preoperative roentgen examination was inadequate, but he does not explain the failure to explore the ethmoid sinus in view of the pronounced orbital symptoms and the negative findings when the antrum was opened.

In Tolan's [122] cases nothing was omitted in the way of diagnosis and therapy. The first patient was a woman of 66 with symptoms of headache and ocular pains for six months, failing vision, exophthalmos and edema of the lids. A growth was seen in the nose, coming from the lateral nasal wall, which biopsy showed to be highly malignant anaplastic transitional cell carcinoma. Roentgen pictures showed destruction of part of the orbital roof, of the lesser wing of the sphenoid bone, of the sella turcica and of the clinoid processes. With roentgen therapy a marked improvement was achieved in the subjective symptoms, and there was roentgen evidence of recession of the growth up to the eighteenth month following the beginning of the treatment. The second patient was a man of 67. He was first treated for sinus disease, because of headaches, but he soon began manifesting more serious orbital symptoms. Roentgen examination revealed destruction of the floor of the sella turcica, of the posterior clinoid processes and of the sphenoid bone. The anterior wall of the sphenoid sinus was removed, revealing a boggy red mass, which on biopsy was described as a "mucous secreting adenomatous tumor with a marked reproduction of gland in a fairly dense stroma with some lymphoid reaction. The tumor seemed to be coming from bone and was pushing a ciliated columnar epithelium ahead of it. The appearance was that of a low-grade malignancy." Since the patient gave a history of having been operated on ten years previously for adenocarcinoma of the rectum it was assumed that the growth in the sphenoid sinus was metastatic.

121. Link, R.: Maligner Tumor der ethmo-orbitalen Region, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **145**:259, 1938.

122. Tolan, T. L.: Report on Two Cases of Carcinoma of the Sphenoid and Ethmoids, Ann. Otol., Rhin. & Laryng. **48**:1069 (Dec.) 1939.

Gauger's [123] case, like Link's and in contradistinction to those reported by Tolan, was diagnosed only at autopsy because of faulty roentgen technic. Since the early symptoms were referable to the ear, the mastoid was opened and nothing unusual found. All the roentgen pictures, which had been taken with the mastoid and the petrosa in mind, failed to show the pathologic changes in the sphenoid bone. Nine days after the operation paresis of the abducens and facial nerves developed, with meningeal symptoms, which rapidly became manifest meningitis, leading to an early death. Autopsy disclosed a malignant growth involving the sphenoid bone and the petrous apex down to the nasopharynx and completely surrounding the carotid canal. (Failure to make proper roentgen studies of the head in all cases of unexplained headache, particularly if there are orbital symptoms, is inexcusable by any standards. S. S.)

NONMALIGNANT TUMORS

Osteoma.—Collins [124] attempts to classify all the bony involvements of the maxillary sinus in contradistinction to those originating in the mucosa. Group 1 includes the noninflammatory ones, such as Paget's disease. Group 2 includes the inflammatory processes, such as creeping periostitis, circumscribed osteitis, localized osteitis and obliterative osteitis. Group 3 is subdivided into tumors of the antrum, such as bone cysts, osteoma, osteochondroma, osteosarcoma and giant cell tumor, and tumors of dental origin, such as dentigerous cysts, follicular cysts and adamantinoma. A number of fine illustrations are submitted, with detailed descriptions of cases of various types of osteitis, which enhance the instructive value of the paper.

Hall's [125] case of extensive osteoma in a dangerous location presented extreme difficulty from the surgical point of view, and the treatment was ably handled, according to the author's description. The mass involved the frontal, ethmoid and sphenoid sinuses, encroached on the dura in the cribriform region and was complicated by purulent infection. It was operated on in two stages. At the first operation a frontal bone flap was raised, the frontal lobe lifted, with the dura, exposing the cribriform plate, and the orbital portion of the tumor was removed. "A sheet of G. P. tissue was introduced under the frontal area to isolate the tumor and the bone from the meninges." The flap was replaced and the wound closed. Two months later an incision was made as for a radical opera-

123. Gauger, K.: Beitrag zur Kasuistik eines von der Keilbeinhohle ausgehenden Felsenbeincarcinoms, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **145**:420, 1938.

124. Collins, E. G.: Osseous Affections of the Maxillary Sinus, J. Laryng. & Otol. **54**:121 (March) 1939.

125. Hall, I. S.: Osteoma Involving the Frontal, Ethmoid and Sphenoidal Sinuses, J. Laryng. & Otol. **54**:217 (April) 1939.

tion on the frontal sinus and the roof of the orbit removed to obtain access to the tumor. The latter was removed in two portions and the cavity trimmed. The gutta percha tissue was easily removed, having served its purpose of walling off the brain. Intranasal drainage was provided, and the patient recovered.

Childrey [126] believes that osteoma occurs more frequently than is generally supposed, having himself found it in 15 of a series of 3,510 roentgenograms of the sinuses. The frontal sinus was the seat of the tumor in 12 of the 15 instances.

Scholz [127] claims that osteoma of the ethmoid bone is very rare and cites Eckert-Möbius as having stated in the Denker-Kahler *Handbuch* that he found it recorded only 55 times in the literature up to 1929. Scholz reports a case. A girl of 16 showed developing exophthalmos over a period of two years, without any other orbital disturbances. A roentgen film showed in the right orbit a large shadow coming from the ethmoid region, which seemed denser in the center than at the periphery. Operation confirmed the diagnosis of osteoma. The mass had a pedicle in the ethmoid wall and grew into the orbit, with displacement of the bulb. The histologic diagnosis was fibro-osteoma. Because the patient's twin sister revealed no similar abnormality, the author concludes that the case speaks against the theory of congenital origin.

Lugli's [128] case was similar. In an 18 year old girl suffering from shooting pains, lacrimation and nasal block, a gradual displacement of the bulb was observed. A dense smooth mass could be felt at the internal orbital angle, and roentgenograms revealed a tumor involving the ethmoid bone, orbit and superomedial angle of the antrum. When the growth was removed, it was found to have eroded the lacrimal bone, paper plate and floor of the orbit. The bone was very dense and lobulated.

In Meyster's [129] patient (a man of 45) the orbital symptoms were less marked, while the nasal symptoms predominated. There were obstruction, lacrimation discharge, pains and polypi and pus in the nose. After the nose had been cleansed, a hard yellowish mass was seen in the middle meatus, extending down to the inferior turbinate; it was visible also on posterior rhinoscopic inspection. It was removed intranasally by chisel and bone forceps. It was quite sclerotic, measured

126. Childrey, J. H.: Osteoma of the Sinuses, the Frontal and the Sphenoid Bone, Arch. Otolaryng. **30**:63 (July) 1939.

127. Scholz, W.: Isoliertes Siebbeinosteom in der Orbita, Ztschr. f. Hals-, Nasen- u. Ohrenh. **45**:86, 1939.

128. Lugli, G.: Osteoma dell'etmoide, Riv. oto-neuro-oftal. **16**:118 (March-April) 1939.

129. Meyster, T. S.: Osteoma of Ethmoid Labyrinth: Case Report, Zhur. ush., nos. i gorl. bolez. **15**:645, 1938.

4 by 4 by 3 cm., weighed 14 Gm. and completely filled the ethmoid capsule without eroding the orbital plate.

Kelemen [130] reports 4 cases of osteoma involving the frontal sinus, in 3 of which it was successfully removed. In 1 case there was histologic evidence of regressive bone formation in the middle of a polypoid structure. In another case there was a bony structure similar to that seen in the late stages of otosclerosis. "A mosaic made up of lamellar or plexiform bone, the pieces of which are separated from one another by fine lines of intercellular substance." The author seems to think that the appearance of this type of bone formation elsewhere than in the petrous bone may mean that it is a purely local phenomenon which should be amenable to surgical removal.

Duydal [131] suggests that the reason why very large osteomas are reported less frequently than in former years is that the more widespread use of roentgen rays in diagnosis makes for earlier discovery of the lesion. The tumor he reports was in a boy of 15. It originated in the floor of the frontal sinus and extended downward into the orbit. The bone mass was extremely dense, showing few cells or marrow spaces.

The growth described by Scalori [132] as osteoma was either inadequately handled in the beginning or else was an inflammatory process rather than a neoplasm. A woman of 40 who gave a history of having suffered a blow over the forehead at the age of 12 had no symptoms until 1932, when slight exophthalmos, impairment of vision and slight vertigo were noted. A roentgenogram showed a shadow in the left ethmoid region, which was taken to indicate the presence of osteoma. The tumor was apparently eradicated by an external operation, but four or five months later the antrum had to be opened because of a recurrence, and a similar mass was removed. Also in the same year the tear sac was extirpated. The woman remained apparently well until 1938, when exophthalmos reappeared with frontal and ocular pains, optic neuritis and congestion of the papilla. A dark red mass was seen in the middle and inferior meatuses, which seemed dense and hard. Roentgen examination showed a mass in the ethmoid region, extending up to the roof of the orbit and into the antrum. External rhinotomy was done and the growth removed piecemeal. During the operation an encapsulated abscess of the posterior ethmoid cell was opened, and the dura was exposed with loss of cerebrospinal fluid. The operation was stopped

130. Kelemen, G.: Frontal Sinus Osteomata, Acta oto-laryng. **27**:528, 1939.

131. Duydal, S. I.: Un cas d'ostéome du sinus frontal droit, Ann. d'oto-laryng., May 1939, p. 461.

132. Scalori, G.: Osteoma etmoido-mascellare recidivo con lesione della dura madre, Valsalva **15**:193 (May) 1939.

and sulfanilamide given for several days, until the fever, headache and discharge of fluid ceased. The operation was then concluded, the tumor being traced to the sphenoid bone and posterior wall of the antrum. Despite a mild lymphocytic reaction in the spinal fluid, the patient recovered after several months.

Cyst.—Hardy,[133] reporting 5 cases of cysts involving the antrum, stresses the differentiation from mucocele, which is more important pathologically perhaps than clinically. There was nothing significant in the clinical histories of the patients. Most of the lesions were discovered in routine roentgen studies. In case 1 the cyst wall was quite thick from considerable plasma cell infiltration; it was lined with cuboidal epithelium and was attached by a pedicle to the outer wall of the antrum. In case 2 the cyst arose from the floor of the antrum; its wall was densely fibrous, and it was lined with stratified epithelium similar to that of the antrum itself. In case 3 a smooth-walled cyst filled the antrum; its walls were densely fibrous and lined with cuboidal epithelium. In case 4 the cyst arose from the roof of the antrum; it had a thin capsule and was lined with cuboidal epithelium. In case 5 the cyst arose from the floor of the antrum, had a thin fibrous capsule and was lined with stratified epithelium.

Weaver,[134] reporting an infected dentigerous cyst, calls attention to the usefulness of dental roentgen films in connection with sinus films. After an attack of "flu" his patient had symptoms suggesting possible infection of an antrum. The sinus was punctured and a small amount of thin fluid recovered. The swelling increased, and roentgen studies revealed an impacted bicuspid, a rather unusual finding. Cellulitis developed, resulting in a spontaneous rupture into the mouth. Operation at a later date disclosed a dentigerous cyst containing a well formed tooth. The lateral wall of the involved antrum had been eroded by pressure.

Reports of postoperative cyst of the cheek still continue to appear in the Japanese literature. The Tanakas[135] report 3 cases. The first cyst described appeared twenty-nine years after a radical operation on an antrum, with pain and swelling in the cheek. At operation two separate compartments were found, covered with dense fibrous tissue and containing thin dark brown albuminous material but no bacteria or cholesterol. The second cyst appeared thirteen years after an operation

133. Hardy, G.: Benign Cysts of the Antrum, Ann. Otol., Rhin. & Laryng. **48**:649 (Sept.) 1939.

134. Weaver, D. F.: Infected Dentigerous Cyst of the Antrum of Highmore: Report of a Case, Proc. Staff Meet., Mayo Clin. **14**:135 (March 1) 1939.

135. Tanaka, K., and Tanaka, Y.: Zur Kasuistik von postoperativer Wangenzyste (Kubo), Oto-rhino-laryng. **11**:1005 (Nov.) 1938.

on an antrum and was similar to the one just described; likewise the third cyst, which appeared seven years after operation. (In these cases, as in many similar ones previously reported, there was a notation that the primary operation was accompanied by considerable bleeding. Undoubtedly, retention of blood clots in a cavity inadequately drained may have had much to do with the subsequent encapsulation for a long symptomless interval. S. S.)

Takahashi's [136] case was not quite so clear. An operation on an antrum had been performed sixteen years before. A swelling appeared in the cheek, and operation disclosed a cyst in the soft tissues, extending into the antrum and ethmoid sinus. It seemed to grow for the most part outside the antrum proper, following the nerves and vessels in the infra-orbital region. The part within the antrum was mostly in the region of the ostium, and there was a fistulous opening leading into the inferior meatus. The cyst wall was lined in part with stratified epithelium, and the cyst contained mucin and cholesterol.

Mucocele.—Razimbaud [137] reports a mucocele of the ethmoid sinus in a girl of 18 years, which was associated with chronic cough and profuse expectoration. The symptoms abated rapidly after the operation. It was found that the mucocele involved the ethmoid sinus and the floor of the frontal sinus, and there was a considerable amount of pus and polypoid material in the sinuses. The cavity itself was lined with fungoid mucosa.

Tiscornia, Just and Mercandino [138] report a case, which they consider rare because the symptoms all pointed to dacryocystitis, and the patient was treated for this in the beginning. A probe passed into the sac yielded much pus, and pus continued to drain. When the sac was finally opened, it was discovered that the cavity was a mucocele leading into the ethmoid labyrinth, which was one large pyocele eroding all the cell partitions and invading the lacrimal fossa through the lacrimal bone. Intranasal drainage provided for future drainage of the infected sac.

Gunn [139] describes a mucocele in a woman of 53. It had eroded the floor of the frontal sinus into the orbit and was displacing the bulb. The roentgen pictures showed the defect in the bone.

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136. Takahashi, T.: Ein Fall von postoperativer Wangenzyste (Kubo), Oto-rhino-laryng. **12**:378 (May) 1939.

137. Razimbaud, J.: Mucocèle ethmoïdale suppurée et dilatation bronchique, Ann. d'oto-laryng., May 1939, p. 503.

138. Tiscornia, A.; Just, B., and Mercandino, C.: Rara evolución de un mucocele etmoidal y propagación a vías lagrimales, Arch. de oftal. de Buenos Aires **13**:485 (Sept.) 1938.

139. Gunn, L.: Mucocele of the Frontal and Ethmoid Sinuses, Canad. M. A. J. **41**:387 (Oct.) 1939.

Berendes [140] reports an unusually interesting mucocele of the sphenoid sinus. It had eroded the roof of the sinus, exposing the dura. Headaches in the temple and at the vertex of several weeks' duration led to roentgen examination of the sinuses, but the results were inconclusive. A septum resection was done without relief of the symptoms. Further inquiry revealed that for several years the patient had experienced some mental confusion with headache and a sensation of pressure in the head. At the time of the operation just mentioned there was a gush of thick yellowish fluid when the mucosa was elevated, and a probe passed into the cavity was shown by a roentgen film to lie in a deep cavity that reached through the sphenoid sinus into the sella turcica. The dorsum of the sinus was then shown to have been eroded. Various bacteria were found in the secretion. The patient went into a collapse. No serious meningeal symptoms developed, and the patient was later operated on again and recovered.

MISCELLANEOUS TUMORS

In a comparatively short space of time Uffenorde [141] had the opportunity of seeing 6 rather unusual tumors about frontal sinuses. The case histories are recorded in detail. The tumors were diagnosed as follows: (1) extensive mucocele, (2) bilateral pneumosinus dilatans, (3) osteoma, (4) true cholesteatoma, (5) giant cell tumor and (6) orbital neurofibroma. Lack of space will not permit detailed review of these interesting cases, but a few of the outstanding data are worth repeating:

The mucocele developed in a man of 48, following a trauma to the head twenty-three years before with unconsciousness, headaches, vertigo and blindness that incapacitated him for years. At the time he was operated on there were marked ocular proptosis, impaired mobility of the bulb, ptosis, pigmentation of the fundus and an irregular walnut-sized tender swelling at the internal orbital margin. The large cystic mass which was uncovered had eroded into the orbit and posteriorly to the dura.

In the pneumosinus dilatans the anterior walls of the frontal sinus were protruded, and roentgenograms showed the sinus enormously increased in size. At operation the ducts were not passable for the average probe. The sinuses were empty. Etiologically, the author suggests three possibilities: (1) a spontaneously drained mucocele, (2)

140. Berendes, J.: Ueber eine Mucocele der Keilbeinhohle, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **146**:189, 1939.

141. Uffenorde, H.: Seltene Geschwulstbildungen im Stirnhöhlengebiet, Hals-, Nasen- u. Ohrenarzt (pt. 1) **30**:246 (July) 1939.

a gas bacillus infection and (3) air trapped in the expiratory cycle because of the constriction of the ducts.

The cholesteatoma was in a woman of 33. There was a history of trauma earlier in life, as a result of which the right eye seemed more deeply set than the left. An intercurrent respiratory infection caused a painful swelling to appear over the eye, followed by exophthalmos. Operation disclosed that the sinus was filled with cholesteatoma, which had eroded the posterior wall over a wide area. The author holds that a thick elastic fibrous network which formed the matrix was an indication that the tumor was true primary cholesteatoma.

The giant cell tumor was in a woman of 64 who had undergone an operation on an antrum and ethmoid sinus fifteen years previously. Recent swelling of the upper eyelid and the inner angle of the orbit led to operation, which revealed several tumors attached to the periosteum of the inner orbital wall. Histologically, these were shown to be giant cell tumors, and the site was then given postoperative irradiation.

The last tumor was a feature of von Recklinghausen's disease in a woman of 35, who had had numerous nodules in various parts of the body since the age of 12. A growth diagnosed as neurofibroma was removed from the upper eyelid when the patient was 18, and since roentgen examination showed a mass still present, another operation was done exposing a similar growth, 1.5 by 3 cm., attached to the supraorbital nerve and the roof of the orbit.

Uiberall and Wulfson [142] describe a rare case. Endothelioma arose in the dura of the middle fossa and grew through the lateral wall of the sphenoid sinus and the orbital fissure. The early symptoms were pains in the first and second divisions of the fifth nerve, followed later by exophthalmos and paresis of the superior oblique ocular muscle. Roentgen films revealed the tumor projecting into the sphenoid sinus from without. External exposure through the ethmoid labyrinth showed the posterior part of the paper plate displaced and granulations at the posterior end of the middle turbinate. Malignancy of the tumor was excluded by the absence of involvement of the mucosa of the sinus and the absence of cloudiness. It was decided not to expose the tumor through the sinuses because of the danger of infection. An approach as for operation on a gasserian ganglion was made, and a tumor the size of a small hen's egg was exposed at the base, which could be only partly removed. The remainder was destroyed by cautery. A histologic diagnosis by Erdheim was "dura endothelioma." It was encapsulated and was considered benign. As a rule, tumors of this type do not erode

142. Uiberall, H., and Wulfson, M.: Ein Fall von Durchbruch eines Duraendothelioms in die Nebenhöhlen der Nase, Pract. oto-rhino-laryng. **1**:416, 1938.

the bone, this one being an exception. A similar case had previously been reported by Erdheim.

Another rare case is reported by Yosida and Nakamura.[143] A 22 year old woman had a tumor of the left cheek for several years, which then became more dense and painful and led to marked nasal obstruction as well as exophthalmos. At operation a large oval-shaped, well encapsulated tumor was enucleated from the ethmoid region. It had attained such a size as to reach the nasopharynx and push the nasal septum toward the opposite side. It was partly bony and cartilaginous, with cystic spaces containing clear, yellowish brown fluid. Histologically, it was typical endothelioma psammosum. The cyst had no epithelial covering.

Capistrano Pereira [144] reports 3 cases of choanal polyp. He prefers to call such polyps choanal-sinusoid rather than solitary polyps. He advises opening the antrum in order to destroy the pedicle and base.

Laff [145] calls attention to polyps in the young reaching such proportions as to spread the nasal bones, causing a broad nose. He offers a photograph of a boy of 15 whose nose shows the deformity described. The polyps were removed in three sittings, after which the nasal bones were infracted to correct the external deformity. The author reviews the literature and finds that allergy plays a role in this condition. His patient had asthma in early childhood.

In a case described by Tanaka and Mihashi [146] a large polyp was found coming from the bulla frontalis and extending into the nasal cavity by way of the nasofrontal duct. The patient also had a choanal polyp originating in the antrum; this polyp was divided into an intranasal and a choanal portion, the two having a common pedicle.

Salvadori [147] describes a papilloma that filled the entire left nasal cavity and extended into the antrum and nasopharynx in a woman of 40. It was removed by lateral rhinotomy. There was no recurrence up to one year.

Androp [148] tells of a 43 year old man who had a swelling of the left cheek which was attributed to a diseased molar tooth. The extraction

143. Yosida, T., and Nakamura, S.: Ein Fall von Endothelioma psammosum des linken Oberkiefers, Oto-rhino-laryng. **12**:485 (June) 1939.

144. Capistrano Pereira: A proposito de alguns casos de polypo sinus-choanal, Brasil-med. **53**:2 (Jan. 7) 1939.

145. Laff, H. I.: Deforming and Recurring Polyps of Youth, Arch. Otolaryng. **30**:795 (Nov.) 1939.

146. Tanaka, K., and Mihashi, N.: Ein Fall von Frontonasalpolyp, kombiniert mit dichotomisch entwickeltem Antrachoanalpolypen, Oto-rhino-laryng. **12**:27 (Jan.) 1939.

147. Salvadori, G.: Sopra un caso di voluminoso papilloma della fossa nasale, del seno mascellare e del rinofaringe, Arch. ital. di otol. **51**:356 (July) 1939.

148. Androp, S.: Adamantinoma of the Superior Maxilla with Intracranial Extension, Laryngoscope **49**:119 (Feb.) 1939.

of the tooth was followed by an extrusion of tumor tissue through the socket. The antrum was opened, a mass removed and the cavity curetted and cauterized. There was a steady loss of weight with a rapid decline from what appeared to be cerebral metastases. Autopsy revealed multiple areas of tumor growth in the dura of the floor of the anterior and middle fossae. Histologically, it consisted of "anastomosing strands of epithelial cells; the cells at the center were undifferentiated, while those at the margins resembled enameloblasts. Mitotic figures were occasionally seen. . . . The dural tumors were quite vascular and contained a number of necrotic areas." The similarity in structure between the tumor of the jaw and those of the dura suggests metastasis. The author, however, believes that the extension was direct.

GENERAL CONSIDERATIONS OF THERAPY

Porter [149] presents an outline of therapy covering a wide range of pathologic conditions of the sinuses which is practical and in line with the best procedures. He believes that much of the reproach heaped on the medical profession by the laity is due to ill advised surgical intervention as practiced by insufficiently trained men. He favors conservative and palliative treatment for acute conditions except the fulminating ones with accompanying orbital and cerebral complications. Here radical surgical intervention may be the salvation of the patient. The author is not favorably inclined to roentgen therapy in chronic sinusitis, judging by the inconclusive results in his own experience and in that of his colleagues. In cases of chronic disease he finds that adequate surgical treatment of the ethmoid cells is often the key to the treatment of pathologic conditions in other sinuses and advises intranasal procedures in most of the cases. Should the frontal sinus be involved to any considerable degree, an external approach by the Lynch or the nonobliterative technic of Killian is preferred. For extremely large frontal sinuses he favors an obliterative operation. He has had good results in treating asthma associated with sinus disease through radical operation, his experience corroborating that of Cook and Grove.

Mithoefer [150] states that when more than one sinus is involved it does not necessarily mean that the pathologic change has advanced to the same degree throughout. Frequently one sinus is the principal offender, the others being involved only secondarily and recovering under conservative treatment when the original focus is radically dealt with. Pains and headaches persisting after apparently successful surgical intervention may be caused by anatomic malformations, and this factor

149. Porter, C. T.: Sinusitis: The Present Rationale of Treatment, Ann. Otol., Rhin. & Laryng. **48**:769 (Sept.) 1939.

150. Mithoefer, W.: Pertinent Facts Relating to Chronic Pansinusitis, Ann. Otol., Rhin. & Laryng. **48**:158 (March) 1939.

plus the neglect of allergic tendencies accounts for the failure to obtain relief in many cases. The author discusses the external frontoethmoid operation and the disappointment frequently caused by failure of the duct to remain open. He offers his own procedure, in which he removes almost all of the ascending process of the superior maxilla, a large part of the nasal bone, the lacrimal bone and the anterior part of the lamina papyracea. He also emphasizes the importance of a mucous membrane flap in these cases to protect the raw bone and the advisability of preserving the mucosa of the posterior aspect of the nasofrontal duct whenever possible.

Morse [151] believes that, whereas most patients with acute sinusitis recover spontaneously under palliative treatment, a certain percentage have persisting symptoms which will yield only to some form of surgical drainage. He cites 7 cases in most of which symptoms of nasal allergy dated from a previous cold and there were no reactions to the usual skin tests. Since in each instance the antrums were persistently dark on transillumination he performed intranasal antrostomy, recovered some mucopus and gave the patient relief. In some cases a submucous resection of the nasal septum was also performed. He calls this combined procedure "physiologic surgery," since it is a means toward aiding nature to rid itself of the disease.

Scantlebury's [152] article presents the usual general considerations of anatomy, physiology, classification and so on. He is impressed with the value of displacement with iodized poppyseed oil in diagnosis. As for surgical treatment, he favors the intranasal operation on the involved antrum except when polyposis is present. For chronic pansinusitis he recommends the external approach as being more thorough.

Bonham [153] comments on the misconceptions of the laity with regard to the sinuses in general and feels that it is important that a patient be warned that even the most successful operation does not bar out the possibility that a cold will be caught at some time or other and that, consequently, the patient should not assume that the drainage incident to the acute condition is a recurrence of the old trouble for which the physician is to blame.

SURGICAL INTERVENTION

General Considerations.—Discussing the general symptoms and the diagnosis of chronic sinus disease, McKenzie [154] claims that surgical

151. Morse, A. W.: The Sinus Problem, Journal-Lancet **59**:87 (March) 1939.

152. Scantlebury, G. C.: Sinusitis, Australian & New Zealand J. Surg. **9**:46 (July) 1939.

153. Bonham, W. L.: The Sinus Problem, J. Oklahoma M. A. **31**:414 (Dec.) 1938.

154. McKenzie, W. R.: The Diagnosis and Management of Chronic Sinusitis, Surg., Gynec. & Obst. **70**:523 (Feb., no. 2 A) 1940.

intervention must be thorough if the diseased foci are to be eliminated. He prefers the external approach in most cases. He has found few patients with frontal sinus disease who required surgical treatment (2 per cent), and with these nothing short of an external procedure was satisfactory. When the ethmosphenoid group of sinuses are involved along with the maxillary sinus, he favors the transantral approach through a Caldwell-Luc opening after raising a triangular mucoperiosteal flap to expose the canine fossa. The operation is done under combined local and general anesthesia (the latter induced with ether) after packing off the nasopharynx. He insists that the middle turbinate bone should not be removed. It may be displaced medially, and if hypertrophied it may be split lengthwise, but under no circumstances should its medial or septal aspect be disturbed. He uses gauze packing with nupercaine ointment, which is removed in twenty-four hours. Irrigations are started after forty-eight hours, and the average period of hospitalization is about ten days. (Most otolaryngologists are opposed to postoperative irrigations in these cases. S. S.)

Hill [155] states the cardinal principles of sinal surgery clearly. For fulminating sinusitis adequate drainage must be provided with a minimum of trauma to bone. For osteomyelitis early and adequate removal of bone is indicated. In most cases of antral infection of dental origin the infection subsides after removal of the dental focus and provision for intranasal drainage. The amount of surgical work necessary in cases of chronic sinusitis depends on the degree and extent of the pathologic change, and on the appraisal of these much depends.

McQuiston [156] calls attention to the importance of the general examination of the patient in connection with contemplated surgical intervention. A proper evaluation of all the pertinent factors contributes much to the success of the treatment indicated.

According to Mayer,[157] the injection of an anesthetic into the ethmoidal nerves in preparation for surgical intervention is generally safe, although accidents and complications do occur. In 150 injections hematoma was produced four times and amaurosis five times, the latter being of only a few hours' duration. Hematoma may occur at once or may be delayed for a few minutes. A typical case is cited. Immediately after injection of a 2 per cent solution of procaine hydrochloride into the anterior ethmoid nerve a hematoma appeared in the orbit with intense swelling and bluish discoloration of both lids. Perception of light was

155. Hill, F. T.: Indications for Surgical Treatment in Sinusitis, Surg., Gynec. & Obst. **70**:531 (Feb., no. 2 A) 1940.

156. McQuiston, R. J.: Surgical Treatment of Sinusitis, J. Indiana M. A. **32**: 466 (Sept.) 1939.

157. Mayer, F. J.: Die mediale orbitale Leitungsanästhesie des Nervus ethmoidalis in der Nebenhöhlenchirurgie, Monatschr. f. Ohrenh. **73**:657 (Oct.) 1939.

lost. After forty-five minutes the pupil began to expand, and the hematoma seemed to soften. In another half hour perception of light began to return, and forty-five minutes later the pupil was reacting, with vision becoming more nearly normal. The fundus was unchanged. In the meantime the operation (West-Marschik) was consummated, and all the untoward symptoms subsided.

Maxillary Sinus.—Hempstead [158] reports 97 per cent good results in a series of 1,634 cases of intranasal antrostomy gathered from the Mayo Clinic and the literature. Among the advantages mentioned in behalf of this procedure are (1) ease of performance, (2) no loss of turbinal tissue, (3) minimum reaction, (4) minimum injury to the mucosa, which rapidly returns to normal, (5) usually spontaneous absorption of polypoid and infected tissue after adequate ventilation and drainage and (6) antroscopic visibility to determine the status of the interior of the sinus at all times. The author states that some antrums require radical operations, particularly those with tumors, thick bony walls or foreign body.

Salinger,[159] who followed Hempstead in a symposium before the American Otological, Rhinological and Laryngological Society, described the indications for the Caldwell-Luc operation on the basis of his own observations and a critical study of the literature. This operation is indicated when roentgen studies with iodized oil reveal marked chronic thickening of the mucosa with or without polypi and when there is a history of long-continued inflammation that has failed to yield to conservative measures. It is particularly indicated in the occult cases in which pulmonary conditions are associated with positive antrum changes. In comparing this paper with Hempstead's the difference is found not as wide as it might appear. It is more than likely that Hempstead and others perform intranasal antrostomy in cases in which the proponents of radical surgical intervention are content to treat by puncture, irrigation, vaccines and other conservative measures, reserving the cases in which the sinusitis is still uncured for radical surgical treatment on the theory that the mucosa is past salvaging. Salinger discusses the details of the operative procedure and postoperative care which contribute to speedy recovery with minimum discomfort.

Moore [160] advocates the intranasal operation for all diseases of the maxillary sinus except cyst, sequestrum or carcinoma. The factors

158. Hempstead, B. E.: End Results of Intranasal Operation for Maxillary Sinusitis, Arch. Otolaryng. **30**:711 (Nov.) 1939.

159. Salinger, S.: End Results of External Operations on the Maxillary Sinus, Arch. Otolaryng. **30**:721 (Nov.) 1939.

160. Moore, P. M.: Intranasal Antrotomy in Maxillary Sinusitis, S. Clin. North America **19**:1243 (Oct.) 1939.

necessary for success are (1) an opening taking in practically the entire nasoantral wall in the inferior meatus, (2) lowering the wall flush with the floor, (3) leaving a pack in the sinus for five to seven days to insure patency of the opening and (4) free drainage. The technical points mentioned are displacement of the inferior turbinate bone, use of Sweet's trocar and rasp to make the initial opening, use of Reave's antrum punch and Yankauer's down-cutting forceps to enlarge it, inspection of the antrum with a scope and loose packing as already mentioned. Several typical cases are cited, including cases of sinusitis due to dental infection, associated allergy and bronchitis.

In cases of purely pyogenic sinusitis Gallaher [161] prefers intranasal antrostomy by means of a drill to minimize trauma. For irrigations he uses physiologic solution of sodium chloride with 0.25 per cent ephedrine. He never finds it necessary to do a Caldwell-Luc operation, even in cases of extreme pathologic change, believing that the large opening and the slow withdrawal of the packing are sufficient, although he fails to explain how this procedure can cure a sinus in which the mucosa is diseased beyond recovery, as it must be in some instances.

Haardt [162] has a new perforating punch forceps, the lower blade of which is bayonet shaped and extends beyond the upper jaw, resembling that of an ethmoid punch. He claims that the advantage of the instrument lies in the ability to perforate the nasoantral wall and bite out a piece measuring 10 by 6 mm. at each maneuver. The opening can thus be made and enlarged speedily.

Theissing [163] reports a case in which he was able to open and drain the pterygoid fossa via the antrum for an infection of dental origin, not knowing that Herrmann had previously proposed the same procedure. In a 27 year old woman, shortly after extraction of an upper wisdom tooth, there developed trismus, pain and fever with swelling of the cheek, foul odor of the breath and inflammation of glands. A chill and leukocytosis led to a diagnosis of a possible ascending infection of the pterygopalatine fossa with probable thrombosis of the pterygoid venous plexus. The swollen palate was incised without obtaining pus. The maxillary sinus was then opened sublabially and its posterior wall taken down, exposing the pterygopalatine fossa. The fascia was opened and an abscess located and drained. Later pus appeared through the previously opened soft palate, and a probe was able to connect the

161. Gallaher, C.: Surgical Treatment of Maxillary Antrum Infections, J. Oklahoma M. A. **32**:27 (Jan.) 1939.

162. Haardt, W.: Ein Instrument zur Kieferhöhleneröffnung im unteren Nasengang, Monatschr. f. Ohrenh. **73**:110 (Feb.) 1939.

163. Theissing, G.: Eröffnung der Flügelgaumengrube durch die Kieferhöhle bei aszendierender dentaler Komplikation, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **146**:362, 1939.

two spaces. The author cites Herrmann as having reported 4 cases; 3 of the patients recovered; the fourth succumbed to endocarditis.

Among several articles on the subject of oroantral fistula which appeared last year is one by Berger,[164] which is well illustrated and explains a comparatively simple technic. After trimming the alveolar fistula to freshen the surfaces, he takes a flap of mucoperiosteum from the gingival sulcus, slides it over the opening and anchors it by mattress sutures.

Ashley [165] takes a flap from the adjacent hard palate, comprising mucosa and periosteum, which he claims is thick enough to plug and seal the fistulous opening irrespective of its size. The distal end of the flap is denuded of its mucosa and plugged into the opening. Then the rest of the flap is slid over the plugged opening and sutured to its freshened margins.

For closure of a large defect in the hard palate following removal of a tumor Pietrantoni [166] recommends swinging a flap of mucosa from the cheek across the defect and suturing it to the opposite margin of the remaining palate. The bony nasoantral wall is then removed and the mucosa laid down from above to cover the cheek flap below. When the two flaps are thus sutured together, the opening is closed by tissues having mucosa on both sides. Colored photographs and case histories accompany the article.

Major [167] describes a sliding buccal flap to close an alveolar fistula which in some respects is similar to that mentioned by Berger. The important points are procuring the necessary thickness of the flap and insuring adequate mobility and blood supply by carrying it sufficiently far onto the cheek.

Frontal Sinus.—Tatrallyay [168] finds little use for the external operation on the frontal sinus except in cases of osteomyelitis or of cerebral complications, because of the resulting deformity and the difficulty of maintaining a patent duct. He is convinced that the intranasal operation if properly performed will accomplish a cure in all types of chronic infection and that it is without danger if certain rules are followed

164. Berger, A.: Oroantral Openings and Their Surgical Correction, Arch. Otolaryng. **30**:400 (Sept.) 1939.

165. Ashley, R. E.: A Method of Closing Antro-Alveolar Fistulae, Ann. Otol., Rhin. & Laryng. **48**:632 (Sept.) 1939.

166. Pietrantoni, L.: Di un metodo personale di plastica del palato dopo asportazione di voluminosi osteomi del mascellare superiore, Valsalva **15**:205 (May) 1939.

167. Major, G.: Buccoantral Fistula: A Method of Closure, Arch. Otolaryng. **29**:319 (Feb.) 1939.

168. Tatrallyay, Z.: The Advantages and Dangers of the Internal Surgical Exposure of the Frontal Sinus, Budapesti orvosi ujság **37**:777 (Sept. 7) 1939.

carefully. The procedure is to open the agger nasi widely, having previously made the typical Halle flap, and to enter the frontal sinus by way of the exenterated anteroir ethmoid cells. Since the posterior wall of the duct is left alone and the mucosa flap covers the denuded bone anteriorly, there is no reason why the duct should not remain open and thus accomplish permanent drainage and ventilation. The author claims to have done this operation successfully in 21 cases of unilateral and 6 cases of bilateral sinusitis.

Kettel [169] reports the results of 40 operations on frontal sinuses by the Bárány technic as performed at the Kommunehospital in Copenhagen, Denmark. Among the complications noted were meningitis (1 case, with recovery of the patient), erysilpelas (1 case), scarlet fever (1 case) and diplopia (4 cases). Thirty-six of the patients were examined at a later date, and 27 were found to be free from all the symptoms they had previously complained of. Four patients mentioned slight periodic discharges from the nose and occasional pain in the frontal sinus. Six patients still had pain, discharges and headache; 5 of them were women, 2 of whom were very nervous. Objectively, 26 of the patients showed excellent cosmetic results; 7 had bad scars. The author emphasizes the importance of care in replacing the periorbita and the value of exact fixation of the trochlea.

In a comprehensive review of 90 cases in which the frontal sinus was operated on at the Marburg Clinic, in Germany, Schultze [170] reports that in 62 (82 per cent) the patients became objectively free from symptoms. The Jansen-Ritter technic was used with the double mucous membrane flap as described by Uffenorde in 1923. Very little of the lamina papyracea was removed lest there should occur a collapse of the orbital contents into the operative cavity, and only enough of the floor of the frontal sinus was taken away to insure adequate drainage.

The mucous membrane of the sinus was removed only if diseased beyond hope of recovery. Primary suture was practiced in all cases except those in which cerebral complications were present. In only 2 cases was there a failure to maintain an adequate opening into the nose, and in only 4 cases did a second operation have to be done. In the entire series of 90 cases there were 35 with intracranial complications.

Würfel [171] presents a résumé of the results of operation in 136 cases at the University Clinic in Berlin, Germany, from 1923 to 1934.

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169. Kettel, K.: Studies on Bárány's Operation on the Frontal Sinus, Ann. Otol., Rhin. & Laryng. **48**:165 (March) 1939.

170. Schultze, L. L.: Zur Anzeigestellung und Ausführung der radikalen Stirnhöhlenoperation, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **146**:194, 1939.

171. Würfel, K.: Die Ergebnisse der Stirnhöhlenoperation nach Sieffert, Ztschr. f. Hals-, Nasen- u. Ohrenh. **45**:47, 1939.

Seiffert's modification of the Killian operation was used. This technic includes the use of a Thiersch graft, wrapped around a finger cot stuffed with gauze, to line the widened duct. Fifty of the patients were examined five years later; 22 reported by mail; 50 were not reached, and the remainder had died. Of 27 patients who were operated on between 1923 and 1928 and examined at later dates, 19 showed excellent scars and were free from all symptoms except occasional neuralgia in the presence of a cold. In 22 of these patients the duct was very patent; in 2 it was not passable, and in 2 a second operation was necessary. Of 23 patients operated on between 1929 and 1934 and reexamined at a later date, 19 revealed widely patent ducts, and 3, constricted but passable ones. The author lays great stress on the function of the epithelial graft in maintaining a patent duct and assisting the regeneration of the mucosa.

Frontoethmoid Sphenoid Region.—In an excellent discourse on the intranasal operation on the ethmoid labyrinth Faulkner [172] presents some wide observations, the result of many years of close observation. He feels that suppurative, hyperplastic and polypoid tissues can be successfully removed intranasally but that much depends on the skill and knowledge of the surgeon. He does not agree with the general impression that complete exenteration by this procedure is impossible. The only exception is a shallow cell extending over the roof of the orbit. He has seen this type of cell missed even in the external operation. He does not favor the use of the rasp for widening the duct. As long as a cannula or a dilator can be passed into the frontal sinus he feels that in most instances this sinus will recover after the ethmoid cells have been well cleaned out. He recalls only 1 case in which a subsequent external operation was necessary. He finds the intranasal operation on the ethmosphenoid cells spectacularly successful in many cases of progressive optic neuritis and has also seen good results in cases of asthma. He deplores the tendency to consider the external approach as the only one that should be used, because his own experience has shown that it is indicated only exceptionally.

Arbuckle [173] likewise reports that in his clinic fewer external operations are being done than formerly. He attributes this to closer investigation and to elimination of the allergic factors present in many cases. He employs the Sluder technic for his intranasal operations but finds the external approach better for the frontal and maxillary sinuses. The external operation when properly indicated has yielded good results, and he cites several illustrative cases.

172. Faulkner, E. R.: End Results of Intranasal Operations on the Ethmoid, Frontal and Sphenoid Sinuses, Arch. Otolaryng. **30**:716 (Nov.) 1939.

173. Arbuckle, M. F.: End Results of External Operations on the Frontal, etmoiditi purulente croniche, Oto-rino-laring. ital. **8**:401 (Nov.) 1939.

Patterson [174] has had good results from the external operation, which he advises only for conditions too advanced for conservative treatment or intranasal surgical approach. Contrary to the advice of some of the authors cited in foregoing paragraphs, he removes the middle turbinate bone, enters the antrum through the middle meatus and does not find it necessary to employ a skin graft, the wide opening into the nose remaining permanently open. Also by removing much of the lamina papyracea he permits the orbital contents to fill part of the operative cavity, which he claims is one way of preventing postoperative crusting.

Caliceti [175] describes an endoexternal technic for chronic disease of the frontal and ethmoid sinuses, which may be done in one or two sittings. He makes a flap similar to that described by Halle and passes a curet into the agger nasi. After clearing out the preturbinal and infundibular cells, he passes the Watson-Williams rasp into the frontal sinus, working only forward. The external opening is made in the anterior wall of the sinus, care being taken not to disturb the area of the junction of the frontal, lacrimal and superior maxillary bones, because he feels that this angle is necessary for the achieving of a good cosmetic result and also to prevent collapse of the duct. The frontal spine is removed by chisel to enlarge the opening, care being taken not to disturb the mucosa on the posterior aspect of the duct. (The difference of opinion on the question of how much bone to remove and on the use of grafts and flaps evidenced in some of the foregoing abstracts shows how far rhinologists still are from the ideal frontal sinus operation. S.S.)

Matis,[176] whose technic of endoexternal subperiosteal opening of the frontal and ethmoid sinuses has been reported on previous occasions,[177] again describes the operation in both English and French.

Vaquero [178] favors Lungo's modification of the original Sewell technic in cases in which complete extirpation of the diseased lining is indicated for the relief of persisting symptoms and especially when previous endonasal procedures have failed to yield the desired results.

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174. Patterson, N.: External Operations on the Frontal and Ethmoid Sinuses, J. Laryng. & Otol. **54**:235 (May) 1939.

175. Caliceti, P.: Il metodo operativo endo-esterno da me sequito nelle fronto-etmoiditi purulente croniche, Oto-rino-laring. ital. **8**:401 (Nov.) 1938.

176. Matis, E. I.: Technique de la méthode opératoire sous-périostée endo-externe des sinusites fronto-ethmoïdales, Rev. de laryng. **59**:766 (Sept.-Oct.) 1938.

177. Salinger, S.: The Paranasal Sinuses, Arch. Otolaryng. **26**:205 (Aug.); 337 (Sept.) 1937.

178. Vaquero, L.: Las ventajas de la trepanación frontoetmoidoesfenoidal por la vía fronto-orbitaria, An. Soc. mex. de oftal. y oto-rino-laring. **14**:17 (Jan.-March) 1939.

He stresses, however, that before embarking on the operation one must eliminate constitutional factors that may be contributing to the symptom complex.

To prevent constriction of the nasofrontal duct from contraction of scar tissue, Williams and Fricke [179] have used radium in 16 cases. Fifteen of the patients were examined subsequently and showed ducts that were sufficiently patent to admit a size 14 French sound. One application of 50 mg. of radium screened by 1 mm. of brass, 0.5 mm. of silver and 2 mm. of rubber, left in situ for three hours, constituted the whole treatment. When this series is compared with a series of 47 cases in which radium was not used and in 6 of which a second operation was required because of contraction of the duct, the new method of treatment seems to be of distinct advantage. Commenting on the technic of the operation for disease of the frontoethmoid sinuses, the authors favor the Jansen incision over Sewell's because it affords more room to work. They do not remove the frontal process of the superior maxilla but are careful to take away the floor of the frontal sinus and the internal spine. For bilateral disease the Lothrop operation is followed, leaving the middle turbinate intact.

Muskat [180] feels that chronic disease of the ethmosphenoid sinuses cannot be successfully or adequately dealt with by the intranasal procedure because of the poor visibility, the irregular ramifications of the cells and hemorrhage. He therefore is strongly in favor of the external approach as described by Ferris Smith. He believes that much of the odium attached to operations on the sinuses in general could be avoided by more thorough surgical treatment in this type of case, in which it is desirable to accomplish more than mere ventilation and drainage. (Compare this point of view with that of Faulkner [p. 553]. Technical skill surely must have something to do with the difference in conclusions similarly arrived at. S.S.)

Brown [181] is an advocate of the transantral approach to the posterior sinuses in cases of pansinusitis. When the frontal sinus is sufficiently diseased to require radical surgical treatment, he favors the Ferris Smith technic and is particularly impressed with the procedure which calls for stripping the mucosa with trinitrophenol in acetone. When

179. Williams, H. L., and Fricke, R. E.: The Use of Radium in Maintaining a Patent Frontonasal Opening in External Operations on the Fronto-Ethmoid Group of Sinuses: A Preliminary Report, Ann. Otol., Rhin. & Laryng. **48**:412 (June) 1939.

180. Muskat, I.: Chronic Nasal Sinusitis and the External Ethmoid-Frontal-Sphenoid Operation, Illinois M. J. **75**:153 (Feb.) 1939.

181. Brown, R. G.: The Radical Operative Treatment of the Posterior Group of the Upper Nasal Accessory Sinuses, Australian & New Zealand J. Surg. **9**:179 (Oct.) 1939.

he feels that the frontal sinus will recover spontaneously, he uses the transantral method, making the openings very large and also providing a large counteropening in the inferior meatus. As long as the anterior and posterior ends of the inferior turbinate bone are left at the normal attachments there is no danger to its vitality even if the rest of the nasoantral wall is removed. The author seems to agree with Pickworth's observation that disease of the posterior sinuses is a frequent cause of mental disturbance, which partly accounts for his desire to be thorough in the eradication of the foci.

NONSURGICAL THERAPY

Jervey,[182] who has long been known as an advocate of conservatism, makes a number of observations that are worthy of repetition, since they are based on careful and conscientious study. Transillumination of the antrum should be done both before and after shrinking the nose, for in many cases of vasomotor rhinitis there will be a marked difference in the amount of light, whereas there will not be a difference if the condition is due to hyperplasia. The author believes that radical surgical attack on the antrum is being done less often than formerly. He finds the intranasal antrostomy adequate in most cases and suggests that the opening need not be excessively large or flush with the nasal floor. Irrigation of the antrum through the ostium can be done in 60 per cent of all cases. He opposes mass suction and recommends displacement by irrigation. He is not sure that roentgen therapy is of much value but sees some merit in local applications of heat and in diathermy. He believes in the efficacy of Kruger's vaccine but has no faith in the local use of vaccine. He is impressed with the value of thyroid extract in many cases as well as with careful attention to diet and an adequate intake of vitamins. Starches, highly milled flours and manufactured sugars in his experience have a tendency to promote continuous mucoid discharge from the nose.

Nelson's [183] article tries to cover too much ground in too short a space, although it may have some value for the general physician.

Griffith [184] makes the point that one must be careful to recognize the patients whose subjective symptoms are out of proportion to the local findings, since these patients require the services of the internist, the gynecologist and the neurologist more than those of the rhinologist.

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182. Jervey, J. W., Jr.: Conservative Management of the Sinuses, South. M. J. **32**:278 (March) 1939.

183. Nelson, O. N.: The Management of Sinusitis, J. Florida M. A. **25**:275 (Dec.) 1938.

184. Griffith, G. E.: Treatment of Chronic Sinus Disease, M. Times, New York **67**:551 (Dec.) 1939.

Patients with obvious findings are easier to take care of. On the other hand, a third group of patients in whom sinus disease is suspected because of symptoms referable to other parts of the body but in whom local symptoms are lacking present a problem which taxes the diagnostic skill of the best physicians. While in many cases the author does not decry the intranasal procedures, he has found that when the symptoms fail to subside and radical surgical treatment becomes necessary the extent of the disease process uncovered more than justifies the radical procedure.

Reinking [185] mentions the tendency to spontaneous cure in acute conditions and the factors that favor it. He uses plenty of fluids, sudorifics, the ultraviolet ray and hypertonic solutions. He also favors the use of tampons of mild silver salts but has no faith in vaccines or autovaccines. He does not favor mass suction, because it increases the hyperemia. Most of the surgical procedures recommended are in line with the customary practices in this country.

Parkinson [186] describes the "lateral head-low position" in which he places the patient, and gives the formula for the isotonic solution he uses, viz., 0.85 per cent sodium chloride in filtered tap water with 1 per cent ephedrine. The solution is boiled and kept in screw-capped bottles (1 to 3 ounces [30 to 95 cc.]) with no preservative or antiseptic. Preliminary shrinkage of the nasal mucosa with 1 per cent ephedrine in physiologic solution of sodium chloride is done before the patient is placed in the lateral position described. The aforementioned solution is then dropped into the nose and allowed to remain for five minutes, and then the head is turned face down. The procedure is repeated on the other side. Mild displacement may be accomplished by having the patient attempt nasal inhalation while compressing the nostrils, thus producing negative pressure in the nasal passages.

Monti,[187] who for years employed sulfurous inhalations plus local applications of a Besredka vaccine, with good results, claims lately to have obtained better results from displacement therapy as modified by Le Mée. He calls this procedure "biologic detersion."

Alagna [188] also finds the Proetz-Le Mée procedure useful both in treatment and in diagnosis. He claims better results from a 10 per cent

185. Reinking, F.: Experiencias en el tratamiento de las supuraciones de los senos accesorios de la nariz, An. Soc. mex. de oftal. y oto-rino-laring. **14**:19 (June) 1939.

186. Parkinson, S. N.: Non-Traumatic Ventilation Treatment of the Nose and Sinuses, J. Laryng. & Otol. **54**:611 (Oct.) 1939.

187. Monti, P. C.: La détersion biologique dans la rhinosinusite ozéneuse avec la méthode de Proetz-Le Mée, Oto-rhino-laryng. internat. **22**:585 (Nov.) 1938.

188. Alagna, G.: Sulla diagnosi delle sinusiti posteriori latenti, con particolare riguardo al metodo del "déplacement" di Proetz-Le Mée, Sett. med. **27**:478 (April 20) 1939.

concentration of iodized poppyseed oil than from the 40 per cent solution. In cases in which there is intolerance for iodine he uses another preparation.

Caruthers [189] reports good results from displacement therapy in 67 cases of acute sinusitis, and in no instance did he find that the infection had been spread to other sinuses by this procedure. He uses a 0.5 per cent solution of ephedrine in saline solution and repeats the displacement and suction until the solution returns clear. The only untoward results noted were temporary increase in headache and stiffness of the neck probably due to the posture.

In experimental studies as well as in observations on patients with acute sinusitis Bryant [190] finds that the Elliott treatment increases secretion of mucus and does not decrease ciliary activity. In some cases by testing with india ink he found ciliary activity greater after the treatment than before. He uses water at a temperature of 118 to 120 F. and later increases it to 125 F. for thirty to sixty minutes. No ill effects have been noted.

Silvers [191] advises the use of a sterile air-conditioning apparatus by which the air is filtered, warmed, moistened and medicated as of great value not only in cases of hay fever and asthma but in cases of acute catarrhal processes as well. He is also enthusiastic over the results obtained with electrosurgical treatment of engorged turbinates, claiming that the destruction of the bacteria by the heat releases end products into the lymphatics which act as an autovaccine, while at the same time there is mobilization of reticular cells, which envelop invading organisms. He makes the statement that "changing the highly columnar and extremely sensitive nasal mucosa to a stratified squamous epithelium as a means of reducing sensitivity to irritants and invading organisms may be open to considerable objection in view of the importance of the ciliated structures in nasal physiology."

Orton [192] offers no specific but suggests some common sense procedures. He mentions the value of sulfanilamide for severe acute infections but cautions against indiscriminate use of this drug.

Fox, Harned and Peluse [193] have employed the Proetz method of continuous suction irrigation for the treatment of subacute residual

189. Caruthers, S. B.: Proetz Displacement Treatment of Acute Sinusitis, Mississippi Doctor **17**:45 (June) 1939.

190. Bryant, F.: Effect of the Elliott Treatment on the Nasal Membrane, Arch. Phys. Therapy **19**:740 (Dec.) 1938.

191. Silvers, L. J.: The Conquest of Sinus Disease, M. Rec. **149**:20 (Jan. 4) 1939.

192. Orton, H. B.: Non-Surgical Therapy in Acute Sinus Disease, Surg., Gynec. & Obst. **70**:535 (Feb., no. 2 A) 1940.

193. Fox, N.; Harned, J. W., and Peluse, S.: Irrigation by Posterior Suction, Arch. Otolaryng. **29**:263 (Feb.) 1939.

ethmoid infection following colds, chronic hyperplasia of the posterior group and retrobulbar neuritis in a large number of cases with good results. They find that the treatment relieves pain due to infection of the maxillary and frontal sinuses and often obviates the necessity for instrumentation. In 4 cases of retrobulbar neuritis the eye returned to normal after an average of thirteen irrigations. When this treatment was augmented by the use of stock vaccine made from filtrates of cultures of bacteria obtained from a large number of victims of common colds, the tendency to recurrence was greatly lessened. They claim there is little danger of spreading the infection to uninvolved sinuses, having observed such an occurrence in only 2 of over 2,000 irrigations on 500 patients.

Beckner [194] claims to be able to irrigate the antrum through the natural ostium in 95 per cent of his cases and the frontal and sphenoid sinuses in 60 to 70 per cent. He also uses argyrol-medicated tampons with 3 per cent ephedrine for twenty minute periods under an infra-red ray lamp.

Merica [195] also finds it possible to irrigate the antrum in 85 to 90 per cent of his cases and believes it is preferable to puncture of the inferior meatus because there is less trauma, less shock and less hemorrhage. He uses a special cannula made of flexible chrome-plated copper, which is easily bent and adapted to the subject.

Hunt [196] describes a specially curved stout needle with a dull point for entering the antrum through the middle meatus. He claims that puncture of the latter is less painful than puncture of the inferior meatus and is applicable in all cases especially in those in which it is difficult to locate the ostium.

TREATMENT WITH CHEMICAL BIOLOGICAL SUBSTANCES

Sulman [197] has used paredrine (parahydroxy-alpha-methylphenethylamine, or beta-parahydroxyphenylisopropylamine) in the ambulatory treatment of a large number of children at St. Vincent's hospital in Philadelphia and finds it less irritating than ephedrine, to which it is closely related; also it affords twice as much and longer-lasting shrinkage. A 3 per cent solution of paradrine hydrobromide is recommended.

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194. Beckner, W. F.: Treatment and Management of Nasal Sinus Disease, West Virginia M. J. **35**:310 (July) 1939.

195. Merica, F. W.: Irrigation of the Maxillary Sinus Through the Ostium: A Clinical Study of Five Hundred Cases, Ann. Otol., Rhin. & Laryng. **48**:1011 (Dec.) 1939.

196. Hunt, W. S.: A New Method of Antrum Lavage, Canad. M. A. J. **40**: 486 (May) 1939.

197. Sulman, L. D.: Paredrine in the Treatment of Sinusitis, M. Rec. **150**: 27 (July 5) 1939.

The local use of sulfanilamide in acute sinusitis due to Streptococcus or to Pneumococcus type III and in all suppurative maxillary sinusitis regardless of infective agent is recommended by Childrey.[198] The procedure is to instill a 2.5 to 5 per cent solution of azosulfamide (neoprontosil; disodium 4-sulfamidophenyl-2′-azo-7′-acetylamino-1′-hydroxynaphthalene-3′, 6′-disulfonate) into the antrum after irrigation and drying with air. The treatment may be repeated three times weekly, and thus far no untoward effects have been observed. Similarly Hirsch-Lorent[199] reports good results from the instillation of 1 cc. of a commercial solution of sulfanilamide in several cases in which operation had been advised and refused. This treatment was given alternately with instillations of 5 per cent iodoform in glycerin, 1 to 2 cc. He cites an illustrative case. A 63 year old man had acute nephritis and an acute infection of an antrum following extraction of a tooth. After other treatments had failed the author employed the procedure outlined and observed prompt recession of both the sinus infection and the nephritis. Examination four months later showed no residual infection. Another case was that of a man of 48 with detachment of the retina and acute exacerbation of chronic pansinusitis due to a streptococcic infection. A cure was obtained after a few treatments.

The Hausers[200] undertook an investigation with three groups of students to determine if possible whether vaccine therapy was of any value in preventing colds; 200 students received subcutaneous injections of vaccines; 100, intradermal injections of vaccines, and 100, injections of a placebo. Fewer colds than in the preceding year were reported by 80 per cent of group 1, 64 per cent of group 2 and 66 per cent of group 3. The authors believe that the difference of the percentages is within the limits of possible error, and since the experiment was inconclusive, they have decided to repeat it next year.

Roberts[201] reports good results from nonspecific therapy in cases in which specific allergens are not found and recommends the application of trichloroacetic acid to the inferior turbinates.

PHYSICAL THERAPY

Ross[202] treated 121 patients with postnasal discharge due to sinusitis by means of roentgen radiation and claims good results. He appar-

198. Childrey, J. H.: Use of Sulfanilamide Locally for Sinal Infection, Arch. Otolaryng. **29**:986 (June) 1939.

199. Hirsch-Lorent, L.: La chimiothérapie de la sinusite, Rev. de laryng. **59**: 864 (Nov.) 1938.

200. Hauser, I. J., and Hauser, M. J.: A Controlled Study of "Cold Vaccines," Arch. Otolaryng. **29**:704 (April) 1939.

201. Roberts, J. D.: Diagnosis and Treatment of Allergy of the Nose and Paranasal Sinuses, Tri-State M. J. **2**:2204 (Jan.) 1939.

202. Ross, W. L.: Clinical Symptoms Useful as a Guide for Roentgen Therapy, Am. J. Roentgenol. **42**:565 (Oct.) 1939.

ently is not concerned with the type or the location of the sinusitis, since little is said about diagnosis. He claims that the treatment reenforces local drainage and promotes more prompt relief. No roentgen pictures were taken for the purposes of diagnosis, the latter being determined by the Edgington method of evacuating the sinuses. The average number of treatments given in each case was from ten to fifteen, and the usual dose for each treatment was 30 roentgens. (Since the treatment was purely empiric and uncontrolled, one has to accept the results with some reserve. S.S.)

In an article on the use of roentgen radiation in the treatment of various conditions of the ears, nose and throat Dysart [203] reports his results in 5 cases of sinusitis. A 14 year old boy with chronic suppuration who had previously been operated on by intranasal antrostomy received several roentgen treatments, followed by displacement therapy, with great improvement in the state of the mucosa, although no statement is given as to the ultimate result. A man of 55 with persisting discharge and pain eight years after an intranasal antrostomy was given several roentgen treatments, with decrease in the amount of discharge, but later he suffered a recurrence. Here also the ultimate result is not given. In 3 patients with subacute sinusitis the results were better. The author recommends small doses, averaging 50 to 75 r. (It is worthy of note that the chronic conditions with advanced changes failed to respond. S.S.)

Hodges and Snead [204] classify sinus infections according to radiosensitivity and find that the subacute and the less advanced chronic ones are the most amenable to roentgen therapy. Radiation therapy is not necessary for acute conditions, and it has little effect on chronic suppurative ones with polypoid degeneration. The authors advise roentgen studies on the chest in every patient presenting one of these conditions and follow-up pictures on those receiving radiation therapy. They claim results as good as those previously reported by one of the authors.

Popp [205] quotes an article by Butler and Wooley and reports on a number of patients who were treated with roentgen rays, with good results. (The 25 with acute disease may be disregarded since, as stated, there is no indication for radiation therapy in this group. S.S.) Eighteen patients with chronic sinusitis were treated; in 6 the condition was cured, and in 4 it was improved. All received up to 1,400 r

203. Dysart, B. R.: X-Ray Treatment of Infections: A Review of the Literature and Report of Cases of Mastoiditis and Sinusitis, Ann. Otol., Rhin. & Laryng. **48**:433 (June) 1939.

204. Hodges, F. M., and Snead, L. O.: The Roentgen Therapy of Carefully Selected Sinus Infections, Radiology **32**:669 (June) 1939.

205. Popp, L.: Röntgenbehandlung der Sinusitis, Fortschr. a. d. Geb. d. Röntgenstrahlen **58**:99, 1938.

in divided doses at two day intervals. The other 8 patients had sinusitis of long standing and had been previously operated on without result. In 5 of this group the sinusitis was cured by roentgen rays, and in 3 it was improved. In this group the author gave up to 2,000 r in divided doses and after a month's rest repeated the treament with 1,000 r.

Russell [206] cites J. B. Sherman as having experimented with vaccines, vitamins and ultraviolet radiation in the prevention of colds and as having found that "the only method of real value was ultra-violet irradiation which reduced both the severity and the number of colds in patients so treated. The method is cheap and easily applicable to large numbers of employees. Its use by big industrial concerns would definitely lower the tremendous economic losses at present caused by the common cold." Sherman's investigation was conducted among a large group, consisting of 593 controls and 1,062 patients actually completing the course.

Hollender [207] finds that the advantage of the short wave over the conventional diathermy is in the fact that it is capable of "overcoming the chronic resistance offered to the ordinary diathermic current by osseous structures and therefore capable of creating heat in bones." His experience leads him to the conclusion that this form of therapy alone cannot cure sinusitis, although it is an effective aid in the treatment. There is some danger in its use in cases of acute sinusitis if there is obstruction to drainage. It is, however, effective for the relief of pain in these cases provided ventilation and drainage have been established.

Jouard [208] also favors short wave therapy and finds it simpler to apply than long wave treatment, since there is no need of specially fitted applicators or moist pads, with the danger of hot spots and blisters. The author agrees substantially with the statements made by Hollender as cited in a foregoing paragraph.

Laszlo [209] finds the short wave beneficial in cases of acute infection for the relief of pain when it is combined with proper shrinkage and ventilation. In 100 cases of chronic disease in which it was used the results were not so good. A number of patients with chronic infection of the antrum who had undergone an adequate course of this therapy were finally forced to undergo surgical treatment. Some of the patients with acute ethmoiditis showed improvement, but the postnasal discharge persisted, and some of them were later operated on. It was found that the

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206. Russell, W. K.: Physiotherapy in the Common Cold and Sinusitis, Brit. J. Phys. Med. **2**:92 (April) 1939.

207. Hollender, A. R.: Short Wave Diathermy in Treatment of Nasal Sinusitis, Arch. Otolaryng. **30**:749 (Nov.) 1939.

208. Jouard, F.: Rationale of Short Wave Diathermy in Acute Sinusitis, Arch. Phys. Therapy **20**:338 (June) 1939.

209. Laszlo, A. F.: Clinical Observations on Short Wave Diathermy in Ear, Nose and Throat Conditions, M. Rec. **150**:21 (July 5) 1939.

treatment had no effect on chronic sinusitis associated with bronchial symptoms. When the conditions were favorable, it was found that children responded better than adults.

CLINICAL OBSERVATIONS

General.—In an excellent study based on comparative anatomy and physiology Taylor [210] shows how aquatic animals are equipped by nature with definite safeguards against the entrance of water into the respiratory tract as well as with a mechanism protective against chilling. Man, however, being a terrestial animal, lacks these natural safeguards, so that when he immerses in a large body of water at a temperature much below his own he not only puts a strain on his heat-regulating apparatus but also subjects the mucosa of the upper respiratory tract to an irritant which in many cases reduces its resistive power to a point at which infective bacteria find ready ingress. Examination of a number of expert swimmers after a long period of submersion revealed reduction of rectal temperature on the average by 4 F., mild cyanosis of the skin, increases in the red and white blood cell counts and marked rises in blood pressure averaging 20 to 30 points in the diastolic phase. The conclusion reached was that prolonged chilling results in peripheral vasoconstriction, peripheral stasis of blood and anoxemia.

Silvers [211] in an article for lay consumption explains in simple terms the dangers to the ears and sinuses from entrance of water into the nasal passages and explains how to breathe to prevent such occurrences and how to protect the auditory canal with greased cotton plugs.

As a basis for roentgen studies of approximately 1,600 heads, Stern [212] attempts to draw certain conclusions as to the possible association between the degree of sinus development and the incidence of infections. He finds no basis for the theory that the size of the sinus has anything to do with a predisposition to infection or vice versa. His findings in cases of ozena corroborate those of other authors. In the antrums it was particularly noticeable that the cavities gained in width at the expense of height.

Ida and Shoji [213] made a number of observations on sedimentation reactions following operations on sinuses and found that values in

210. Taylor, H. M.: Otitis and Sinusitis in the Swimmer, J. A. M. A. **113:** 891 (Sept. 2) 1939; The Hygiene of Swimming, Virginia M. Monthly **66:**32 (Jan.) 1939.

211. Silvers, L. J.: Swimming Safely, Hygeia **17:**596 (July) 1939.

212. Stern, K.: Bestehen Beziehungen zwischen Nebenhöhlenentzündungen und der Pneumatisation von Kiefer- und Stirnhöhle? Eine röntgenologische Studie, Hals-, Nasen- u. Ohrenarzt (pt. 1) **30:**301 (Sept.) 1939.

213. Ida, T., and Shoji, N.: Einfluss der Nebenhöhlenoperation, betrachtet aus der Senkungsreaktion des roten Blutkörperchens, Oto-rhino-laryng. **12:**191 (March) 1939.

excess of 60 should excite suspicion of complications and that those over 80 definitely indicate complications. The reaction, as a rule, reaches its height about four days after operation and then gradually diminishes to normal in about ten days. The relationship of the reaction to body temperature is not always even, and hemorrhage seems to have little influence on the degree of reaction.

Discussing types of sinusitis and their complications, Leroux [214] expresses the conviction that certain persons acquire chronic infections because of inherited tendencies, the usual local predisposing factors being frequently absent. He believes that in most of the cases disease of the frontal and ethmoid sinuses is engrafted on a chronic infection of the antrum and therefore feels that it is dangerous to allow such an infection to lie dormant without attempting to cure it. His experience with frontal sinusitis is that the condition is usually bilateral, and therefore he performs the Sibeliau operation, which drains both sinuses. He describes as "edemato-polypoid" disease of the sinuses a condition which my colleagues and I are wont to recognize as chiefly allergic, and he claims that 50 per cent of his asthmatic patients are cured by a radical surgical procedure when this is successful in preventing the recurrence of polypi.

Seaver [215] shows that a diet rich in refined carbohydrates deprives the patient of basic chemicals present in the discarded residue, which causes a deficiency in vitamin B and is frequently the cause of recurring colds and persisting infection of sinuses. He reports definite improvement in 30 private patients who were treated with spintrate (a spinach preparation) and the entire vitamin B complex.

Jarvis [216] finds that the ingestion of starches and disaccharides beyond the patient's tolerance causes a block in cell oxidation which leads to increased nasal discharge and an increase in the lymphatic structures of the pharynx. Such patients are more susceptible to infection that they would be otherwise. Indicative of this state are insomnia, migraine, vertigo, cramps, neuralgia and symptoms of fatigue, and the remedy suggested is replacement of wheat and cereals in the diet with corn, oatmeal and rye flours and substitution of honey for sugar, apple and pineapple juice for citrous fruits and sea foods for muscle meats.

Gatewood [217] believes that in many cases perennial hay fever is due to an old infection of the antrums, the swollen mucosa being sensitive

214. Leroux, L.: Schéma des sinusites et leurs complications, Progrès méd. **67**:196 (Feb. 11) 1939.

215. Seaver, E. P.: Chronic Infectious Nasal Sinusitis and Refined Carbohydrates in the Food Selection, Tr. Am. Laryng., Rhin. & Otol. Soc. **44**:302, 1938.

216. Jarvis, D. C.: Applied Biochemistry in the Etiology and Treatment of the Nasal Accessory Sinuses, Laryngoscope **49**:186 (March) 1939.

217. Gatewood, E. T.: Diagnostic Methods Which Have Served Me Best in Determining Sinus Disease and So-Called Hay Fever, Virginia M. Monthly **66**:465 (Aug.) 1939.

to pollens and other irritants. In childhood chronic sinusitis may be overlooked until it is excited by swimming or until bacterial allergy has developed. Recurring colds, sneezing attacks, cough, abdominal distress and nausea should lead one to suspect infection of the sinuses.

Scholz [218] advises that all patients with recurring polypi be studied for allergic factors and recommends not only that the usual cell count on smears be made but also a biopsy of tissue for a possible infiltration with eosinophils. In addition to specific allergens, he recommends intravenous use of calcium, a vegetable diet, restriction of fluids and local application of trichloroacetic acid.

Hays [219] discusses the differential diagnosis between headache due to sinusitis and true migraine as well as headaches of gastrointestinal and ocular origin and offers a number of practical points in therapy. He thinks well of the use of ergotamine tartrate in cases of severe headache and touches on some useful points in the administration of this drug.

Lahme and Uffenorde [220] contribute an article on pain which is more or less in the nature of a textbook article. They mention nerve connections via the ciliary, otic and sphenopalatine ganglions as pathways for the transmission of pain to distant points.

Monti [221] presents a review of the literature on focal infection from the publications of Billings down, with liberal quotations from Watson-Williams, Graves, Pickworth, Rosenow and others. Nothing new is offered by way of corroboration. Granger's [222] comments are also of a general nature, with emphasis on conservatism in therapy.

Smith [223] believes that in many cases chronic nasal trouble is due to unsuspected syphilis. He quotes Graham to the effect that the mucosa of the syphilitic nose has a bluish tinge, due to perivascular round cell infiltration, and that large turbinates, persistent stuffiness, oversecretion and frequent colds in the absence of positive evidence of sinusitis should lead one to suspect syphilis. Several typical cases are cited, and stress is laid on characteristic roentgen findings of a blotchy character.

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218. Scholz, W.: Ueber Nebenhöhlenentzündungen bei Allergikern, Ztschr. f. Hals-, Nasen- u. Ohrenh. **45**:14, 1939.

219. Hays, H.: Comments on Headaches, M. Times, New York **67**:555 (Dec.) 1939.

220. Lahme, H., and Uffenorde, W.: Ohr- und Nebenhöhlenschmerz, Deutsche med. Wchnschr. **65**:179 (Feb. 3) 1939.

221. Monti, P. C.: Infezioni focali e otorinologia, Boll. d. Ist. sieroterap. milanese **18**:466 (July) 1939.

222. Granger, W.: Sinus Trouble and Its Non-Operative Treatment, J. Kansas M. Soc. **40**:375 (Sept.) 1939.

223. Smith, A. T.: The Importance of Syphilis in the Diagnosis and Treatment of Lesions of the Nose and Sinuses, Pennsylvania M. J. **43**:252 (Dec.) 1939.

Taptas [224] says that one should not pinch the nostrils when blowing the nose, because of the danger of forcing infective material into the eustachian tube and orifices of the sinuses through an increase of air pressure beyond a certain point.

Maxillary Sinuses.—Kecht [225] cites Eckert-Möbius as having stated in the Denker-Kahler *Handbuch* that he had found only 27 cases of cholesteatoma of the sinuses described in the literature. Kecht reports a case. A man of 21 had been struck over the cheek in childhood so that there remained a permanent depression in the contour. For a number of years he suffered from vasomotor rhinitis. During the past few months he had noticed encroachment on the visual field by a swelling below the orbit on the affected side. It felt like a soft mass in intimate relationship with the orbit. Puncture of the maxilliary sinus gave negative results. Roentgen pictures showed a dark shadow in the antrum, suggesting a cyst. Mucocele was diagnosed. A Caldwell-Luc exposure disclosed a thick anterior sinus wall. The sinus was devoid of mucosa and was filled with cholesteatomatous material in compact layers. The roof of the antrum was eroded in places. The author's theory as to the origin of the mass is that the fracture was accompanied by hemorrhage into the sinus with resulting metaplasia of the epithelium. The patient recovered.

Boudial [226] describes as serous maxillary sinusitis a condition which my colleagues and I are accustomed to attribute to allergic influences. He makes a distinction between the cases of continuous serous discharge and those of a discharge that is intermittent. In the former, he believes, the pathologic condition is a simple local vasomotor response whereas in the latter it is more typically allergic.

Walsh [227] reports a case of agranulocytosis associated with Streptococcus viridans infection of the antrums, both of which yielded pus. From an initial count of 2,600 white cells with no granulocytes the blood picture gradually improved under irrigations, transfusions and feeding with yellow bone marrow. The author states that Str. viridans is commonly found in association with agranulocytosis but that the disease cannot be reproduced in animals by bacterial inoculation.

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224. Taptas, N.: L'acte de sé moucher et ses rapports avec les fonctions physiologiques des cavités naso-paranasales et les oreilles, Ann. d'oto-laryng., June 1939, p. 569.

225. Kecht, B.: Ueber ein Fall von Cholesteatom der Kieferhöhle, Ztschr. f. Hals-, Nasen- u. Ohrenh. **46**:184, 1939.

226. Boudial, A.: Les sinusites maxillaires séreuses, Médecine **19**:76 (Jan.) 1938.

227. Walsh, T. E.: Agranulocytosis Associated with Maxillary Sinusitis, Arch. Otolaryng. **29**:388 (Feb.) 1939.

A case of von Recklinghausen's disease in which the maxillary sinus was involved is reported by Urfer.[228] A man of 29 complained of a sensation of pressure in the right cheek for several years. Puncture of the antrum yielded a clear brownish fluid. Roentgen films showed the floor of the orbit displaced upward and the nasoantral wall pushed medially by a mass which seemed to have thinned out these bony walls considerably. Granulomas were found at the apexes of several teeth, with cystic degeneration of the mandible. Also there was a history of spontaneous fracture of the humerus, and additional roentgen pictures revealed cystic masses in the humerus and in the ilium. At operation the antral walls were found to have been absorbed to a large degree by a cystic mass which filled the sinus and contained brownish fluid and soft tumor masses. Histologic examination revealed the usual giant cells, fibroblasts and lymphocytes. The blood calcium was 20 mg. per hundred cubic centimeters. A small tumor of a parathyroid gland was removed later. The blood calcium dropped to between 7.5 and 9.1 mg. per hundred cubic centimeters, and the patient recovered.

Syphilis of the nose affecting the antrum is reported by Cora Eliseht and Aguero,[229] in a child of 8 who for eight months had suffered from persistent coryza, abundant mucopurulent secretion and intermittent epistaxis, which was unilateral. Roentgen films showed a very dark antrum, which seemed altered in size and shape. The ethmoid and frontal sinuses were also cloudy. The nose on the affected side was blocked by a bulge in the nasoantral wall. An area of inflammation was found in the hard palate on the same side. A history of congenital syphilis was borne out by the Wassermann test, and the symptoms disappeared after active antisyphilitic therapy.

Rentschler and Scheifley [230] report a fungus infection of the antrum in a woman of 49. The space between the lateral nasal wall and the middle turbinate was filled with a semiinspissated nonodorous material which looked like blotting paper and came away in chunks. The antrum was dark. Smears showed spore forms and mycelial processes. Culture yielded Aspergillus niger. Turbinectomy and antrostomy were performed, and a cure followed in about three weeks. The authors advise internal administration of iodides in such cases in addition to the local treatment.

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228. Urfer, F.: Contribution casuistique à la maladie de Recklinghausen avec participation du sinus maxillaire, Ann. d'oto-laryng., November 1938, p. 1047.

229. Cora Eliseht, F., and Aguero, A.: Sifilis terciaria del seno maxilar, Rev. Asoc. méd. argent. **53**:290 (April 30) 1939.

230. Rentschler, H. D., and Scheifley, C. H.: Fungous Infections of the Sinuses, Arch. Otolaryng. **29**:147 (Jan.) 1939.

Lacorte and Santos [231] report a rare case. Gonococcic infection appeared in the antrum and ethmoid labyrinth a few months after urethral infection and persisted for twenty years. It was finally cured by radical surgical intervention. The bacteria were identified by smear and culture.

Dymov [232] describes several cases in which facial erysipelas complicated nasal sinusitis. He believes the infection was transmitted from the sinuses either by way of the infraorbital foramen or by way of the lymph vessels. (Contamination by infective secretions is more than likely. S. S.) The facial eruption was dispelled by the use of ultraviolet rays from a quartz lamp, after which the sinuses received appropriate treatment.

Role of Dental Infections.—Infection of the antrum of dental origin was the subject of extensive discussion in the section on laryngology of the Royal College of Surgeons.[233] Pitts found that this association resulted most frequently from accidents during removal of teeth. In his experience there were very few instances of such infection resulting from pyorrhea or granuloma and none in which it was due to acute dental infection. He was definitely opposed to widening a tooth socket in search of a root that had pushed into the antrum and advised opening the antrum through the canine fossa. Hardy agreed with Pitts on this point. He mentioned carcinoma as a frequent cause of extension from the alveolus to the antrum. Wright added dental cysts, periodontal disease and infection of the tooth pulp as possible causes of infection of the antrum, since osteitis of the alveolus does occur and may progress in the direction of the antrum floor. If the antrum is accidentally opened during the removal of a tooth, he advises expectant treatment and cautions against irrigations through the socket. If a portion of a molar root is broken off and remains behind, he recommends informing the patient but suggests that nothing be done unless indicated by subsequent symptoms. If an antrum is diseased and several teeth also are involved, it may be wise to open the antrum, the incision being made low enough to permit inspection of the recess with the idea of removing only such portions of the mucosa as are grossly involved. Davis found in his experience that 20 per cent of antral infections were of dental origin. If a tooth is pushed into the antrum, he holds that it is often better to wait until the edema subsides before making an opening through the

231. Lacorte, J. G., and Santos, M.: Sinusite maxilo-etmoidal gonocócica, Acta med., Rio de Janeiro **2**:478 (Dec.) 1938.

232. Dymov, K. M.: Erysipelatous Inflammation of the Face Complicating Acute Sinusitis, Vrach. delo **21**:443, 1939.

233. Discussion on Antral Infection of Dental Origin, J. Laryng. & Otol. **54**:493 (Aug.) 1939.

canine fossa. Stone's experiments with pyorrhea showed that only in 15 per cent of the cases was there any evidence of underlying disease of the bone.

Scholz [234] believes that periapical infection may involve the antrum more frequently than is generally supposed. Extension of disease from a tooth socket is not periostitis but paradentitis, since it involves the paradentium, which sheathes the tooth and acts as a lining of the socket, forming a cementing substance between the root and the surrounding bone. He quotes Siegmund to the effect that periapical infection extends via the lymph channels, emerging from the apex of the root and leading directly into the bone marrow. Dyes injected into the root canal may later be found in the histiocytes along the vessels and in the cells of the bone marrow in a fan-shaped area about the root. Various types of pathologic change may result from granuloma or an apical abscess, such as secondary inflammatory changes, direct empyema of the antrum and cyst formation. The author recalls that the effects of apical infection are both local and constitutional, and he seeks to impress the physician with the importance of close study of the teeth and particularly of the state of the paradentium. In cases in which a focus of infection is being sought the state of the antral mucosa and its possible association with infection of the adjacent teeth assumes major importance, and roentgen studies with and without contrast mediums should be thoroughly carried out.

Austin and Hempstead [235] also emphasize the value of roentgen studies of the teeth in connection with disease of the antrum and show a number of pictures illustrating such a pathologic development. Failure to cure an infection of an antrum by operation may be due to a dental infection which has been overlooked. Dental roentgen films in such cases may show an infected root projecting into the floor of the antrum, a granuloma at the apex, a dentigerous cyst or another abnormal condition. It is important that the dentist as well as the rhinologist be trained to read both types of films so as to recognize pathologic appearances in both fields.

Novitzky [236] finds that dead upper teeth may frequently have roots projecting into the floor of the antrum and giving rise to symptoms referable to the sinus. The removal of these teeth must be carefully done under direct vision, with good hemostasis. If in the removal of dead upper teeth, one finds a pathologic perforation into the antrum and

234. Scholz, W.: Zähne, Zahnsystem und Kieferhöhlenerkrankungen, München. med. Wchnschr. **85**:1778 (Nov. 18) 1938.

235. Austin, L. T., and Hempstead, B. E.: Dental Roentgenographic Evidence: Infection of the Maxillary Sinus, J. Am. Dent. A. **26**:1849 (Nov.) 1939.

236. Novitzky, J.: Dead Teeth and the Antrum of Highmore, Am. J. Surg. **46**:370 (Nov.) 1939.

necrotic bone about the socket, this diseased tissue should be removed. If the mucosa of the antrum looks normal, it should not be disturbed. If, on the other hand, it appears diseased, it should be excised widely enough to permit a search of the sinus for the presence of granulations or polypi. Careful dry cleansing (no irrigations) and primary closure should conclude the operation.

Clark [237] advises prompt removal of broken-off molar roots in preference to waiting for symptoms. It is important always to determine whether the floor of the antrum has been perforated. He recommends curetting diseased bone and then protecting the opening with a prosthesis to prevent entrance of food. (This is contrary to the previous author's recommendation. S. S.) He does not think that an intranasal antrostomy is necessary unless the sinus has been definitely shown to be infected.

Malone [238] is emphatic in advising against treating secondary infection of an antrum through an alveolar opening. Such a passage is unnatural and affords oral sepsis easy access to the antrum. It should be freed from granulations and closed as soon as possible. The antrum must be drained either through an intranasal antrostomy or a Caldwell-Luc opening, as the case may be.

McLane [239] cites 5 cases of infection of an antrum following removal of molar teeth. In several of these cases the extraction preceded the symptoms by years. He points out the importance of a careful follow-up if during extraction there is some suspicion that the antrum has been perforated or if disease at the apex suggests the possibility of a spread of the infection. Among his patients were 2 with severe arthritis, which cleared up after radical operation on the antrum. In these and other cases cited there were pathologic changes in the floor of the antrum over the area of the extracted tooth.

Scarcella-Perino [240] reports a case of chronic hyperplastic maxillary sinusitis due to an unerupted central incisor. There was a history of long-continued pain radiating up to the orbit, with the appearance of a fistula in the floor of the nose. Before adequate roentgen pictures were taken the patient had two other incisors removed in an effort to obtain relief, and it was only when a later picture showed the unerupted tooth lying diagonally in the bone, a large area of which was absorbed, that

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237. Clark, J. S.: Suggestive Treatment of Maxillary Sinusitis Subsequent to Dental Surgery, Illinois M. J. **76**:130 (Aug.) 1939.

238. Malone, P. W.: Maxillary Sinusitis of Oral Origin, Texas State J. Med. **34**:774 (March) 1939.

239. McLane, J. N.: Maxillary Sinusitis Associated with Dental Caries, J. Florida M. A. **25**:566 (May) 1939.

240. Scarcella-Perino, G.: Sinusite cronica plastica da dente ritenuto, Stomatol., Modena **36**:881 (Dec.) 1938.

the true diagnosis was apparent. The antrum was also infected, and a radical operation with removal of the tooth and adjacent diseased bone resulted in complete recovery.

Severe dental pains the result of a low grade infection of an antrum may lead to needless sacrifice of healthy teeth when the diagnosis is obscure. Collins and Hargett [241] report 3 cases of this type. It is important, therefore, that when there are no local indications of disease in the teeth or gums the antrum should be thoroughly investigated and observed even though the initial findings are minimal. In one of the authors' cases the pain was due to an allergic swelling of the mucosa of the sinus; in another it was due to a very low grade antritis, and in the third case it was the residuum of a recent acute infection.

Ruf [242] states that desensitization of teeth following radical operation on an antrum does not imply impairment of the vitality of the teeth unless the root or the peridentium has been directly traumatized. The rich anastomosis of the rami dentales as well as the vascular supply of the peridentium insures the vitality of the pulp despite loss of sensation. Neither are these teeth more susceptible to caries because of absence of warning pain than the teeth of the opposite side, as proved by a check-up of a large series of cases. In most cases the nerves eventually regenerate.

Frontal Sinuses.—The term "latent frontal sinusitis" is used by Bondet and Flandrin [243] in referring to an acute infection which has apparently subsided but which, after a symptomless interval, will become manifest in the form of a severe intracranial complication. They report 4 cases of this type. In the first there was slowly developing local osteomyelitis, with recovery; in the second, osteitis of the external table, with recovery; in the third, abscess of a frontal lobe, with recovery, and in the fourth, bilateral abscess of the frontal lobes, which was fatal. The authors agree that it will always be difficult to distinguish between acute frontal sinusitis with latency tending to complications and the process which is truly subsiding. While they agree further that most acute infections of the frontal sinuses should be left alone, they are impressed nevertheless with the importance of giving heed to any subjective symptoms of which the patient complains despite the absence of local findings, lest one be caught napping when it is too late. A study of the patient's temperament and character previous to the acute infection, as elicited

241. Collins, J. P., and Hargett, E. R.: Dental Pain of Antral Origin, J. Am. Dent. A. **26**:84 (Jan.) 1939.

242. Ruf, C.: Der Zahnstatus nach der Radikaloperation der Kieferhöhle, Hals-, Nasen- u. Ohrenarzt (pt. 1) **30**:269 (July) 1939.

243. Bondet, C., and Flandrin, J.: Contribution à l'étude des sinusites frontales latentes, Ann. d'oto-laryng., July 1939, p. 675.

from the near relatives, may justify a suspicion that a change in these characteristics means serious trouble brewing which calls for prompt action.

Giovanni [244] reports a case of pulmonary tuberculosis, ozena and symptoms of an involvement of a frontal sinus, with bulging of the floor toward the orbit as from a mucocele. Autopsy revealed that the sinus was filled with thick fetid mucus and that the mucosa was very thick and irregular, the bony walls thin and the duct almost completely blocked by swelling. There was no evidence of local tuberculosis, and the author concludes that the process was incidental, having no connection with either the tuberculosis or the ozena except that of having been contracted while the patient's general resistance was weakened.

A true case of tuberculosis of the frontal sinus is reported by Sarasina and Tomita.[245] A 12 year old girl had a swelling in the frontal region one month after an acute infection of the upper respiratory tract. The swelling when incised yielded a thin purulent secretion. The nasal examination gave negative results; likewise, the Wassermann and Pirquet tests. Roentgen pictures revealed almost total absence of the frontal bone down to the orbital margin. Roentgen pictures of the chest showed a shadow in the lower lobe of the right lung. The frontal sinus was opened and carious bone encountered. The sinus was full of cheesy exudate. There was a gradual reduction in the swelling, but ten days later a tumefaction appeared over the opposite frontal bone, which was opened, revealing similar findings. Histologic examination of the tissues demonstrated tuberculosis, evidently metastatic from the pulmonary focus. The frontal fistulas healed after prolonged convalescence.

Hornicek [246] discusses syphilitic involvement of the sinuses, which is quite rare, and reports 2 cases. One must differentiate true syphilis of the sinus from nonsyphilitic sinusitis occurring in a syphilitic patient. When involving a frontal sinus the process is usually very insidious, and once it advances to the stage at which symptoms are present, one will find roentgen evidence of extensive destruction of bone. When the diagnosis is made, the treatment should include thorough eradication of the local disease in addition to active antisyphilitic treatment.

Soto [247] presents a number of roentgen pictures to demonstrate the differential diagnosis between osteitis frontalis interna, acromegaly,

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244. Giovanni, B.: Tuberculosi polmonare, ozena nasale, sinusite frontale iperplastica, Ann. di laring., otol. **39**:59, 1939.

245. Sarasina, K., and Tomita, T.: Stirnhöhlentuberkulose hervorgengangen aus der Stirnbeintuberkulose, Oto-rhino-laryng. **12**:199 (March) 1939.

246. Hornicek, V.: Syphilitic Frontal Sinusitis, Časop. lék. česk. **78**:26 (Jan. 6) 1939.

247. Soto, O.: Diagnóstico radiológico diferencial de la hiperostosis frontal interna, Rev. neuro-psiquiat. **2**:325 (Sept.) 1939.

hemicraniosis, Paget's disease and leontiasis ossea. The pictures are not sufficiently clear to be of much value, but the text is fairly detailed and accurate.

Roger, Schachter and Boudouresques [248] report a case in which the diagnosis was between compression of the medulla oblongata, medullary syphilis, a neurotropic virus infection and a vascular syndrome of the cervical part of the medulla, but which proved to be a case of osteitis frontalis interna when routine roentgen pictures of the skull were examined. Autopsy revealed large frontal sinuses, the posterior walls of which were 2.5 cm. thick for a distance of 7 cm. extending from below upward. The posterior clinoid processes were gone, the anterior clinoid processes thickened by periosteal reaction, the dura densely attached, the arachnoid engorged and the brain congested. The psychic disturbances were not as pronounced as those described by Morel, which may account for the diagnosis being missed until the roentgen pictures were seen.

Trelles and Mendez [249] report 4 cases of the Stewart-Morel syndrome with a discussion of the causes, symptoms and genesis of the disease. They cite Carr as having obtained good results from the use of amino-acetic acid. The usual symptoms of hyperostosis of the internal frontal plate, obesity, mental and psychic disturbances, headache, polyuria, hypertension and virilism were present in their cases.

Five cases of Morgagni's syndrome were presented by Korpassy.[250] The patients were women between the ages of 59 and 91, and the characteristic manifestation of their condition was general hyperostosis of the calvarium, which was noninflammatory. Neurologic symptoms and evidence of virilism were absent, but obesity was pronounced in every instance, which would lead to the presumption that the glands of internal secretion were at fault. Postmortem examination of these tissues, however, failed to reveal any abnormality.

Ventura-Gregorini [251] describes osteitis fibrosa affecting one frontal sinus in a child of 11. There was no history of trauma. The lesion appeared in the frontal region as a soft mass eroding the anterior wall of the sinus and encroaching slightly on the orbit. Operation disclosed a soft dark gelatinous mass filling the sinus and eroding both the orbital

248. Roger, H.; Schachter, M., and Boudouresques, J.: Troubles vasculaires médullaires du vieillard (ramollissement ou hématomyélie) et syndrome de Morgagni. Hypérostose frontale interne, virilisme et obésité, Marseille-méd. **76**:92 (July 15) 1939.

249. Trelles, J. O., and Mendez, M.: Sobre cuatro casos de sindrome de Stewart-Morel, Rev. neuro-psiquiat. **2**:342 (Sept.) 1939.

250. Korpassy, B.: Morgagni's Syndrome, Magyar orvosi arch. **40**:273, 1939.

251. Ventura-Gregorini, F.: Osteite fibrosa destruente de seno frontale, Arch. ital. di otol. **51**:303 (June) 1939.

and the cranial plates. Histologic examination revealed a highly cellular mass with a calcareous hyaline stroma. The patient when seen a year later was apparently well, with normal vision.

In a case reported by Shimizu [252] acute frontal sinusitis in a young man of 19 was complicated by a subperiosteal abscess which apparently had no direct connection with the sinus, since a fistula was not demonstrated. A radical operation was performed, and the sinus lining was found to be thickened, hyperemic and partly necrotic. Sepsis followed, which resulted fatally. The author reviews 47 fatal cases of frontal sinusitis which he found described in the literature and finds that such disease has been more common in men than in women and that subperiosteal and orbital abscesses have been the most frequent complications. A fistula in the bone was present in only 3 cases. (Evidently the paravascular extensions are more serious than those which progress by direct erosion. S. S.)

Ethmoid-Sphenoid Sinuses.—Lathrope [253] believes that in many cases chronic disease of the ethmoid cell is overlooked because of the difficulty of making a positive diagnosis. He found that in 58 per cent of 104 consecutive cases the disease involved the posterior group alone and that in 32 per cent the involvement of the posterior cells was in combination with disease of some of the anterior group. The principal symptoms were lassitude, rheumatic aches and pains, and frequent colds. There were 5 cases with ocular complications, in 3 of which these were very serious. In 9 cases there were no local subjective symptoms despite definite findings. In many cases the sinus disease was discovered only after careful search for a focus of disease causing symptoms at a distant point.

Shambaugh [254] also has found many cases of low grade disease of the ethmoid cells in which the local symptoms were minimal and the roentgen findings doubtful but in which the sinuses were suspected because of vague headaches, fatigue, postnasal discharge, and pains in the muscles and nerves at remote points. As a diagnostic procedure he recommends first cleansing the nose and throat of all secretions and then using a 0.25 per cent solution of ephedrine in physiologic solution of sodium chloride by the Proetz method. If this procedure is followed by the expulsion of mucus plugs or mucopus within a short time, it points

252. Shimizu, M.: Ein Todesfall von Sinusitis frontalis acuta dextra: Anhang: Statistische Ergebnisse der Stirnhöhlenentzündung, Oto-rhino-laryng. **12**:18 (Jan.) 1939.

253. Lathrope, G. H.: Chronic Paranasal Sinusitis, J. M. Soc. New Jersey **36**:542 (Sept.) 1939.

254. Shambaugh, G. E., Jr.: Obscure Low-Grade Chronic Infections of the Ethmoid Sinuses, J. A. M. A. **112**:1226 (April 1) 1939.

strongly to the ethmoid cells as the source. This displacement therapy, repeated every few days, has yielded excellent results in a series of cases reported by the author.

Fractures; Foreign Bodies.—Brody [255] presents an analysis of 9 cases of meningitis following skull fracture in which the sinuses were involved. The details are interesting and worth abstracting.

1. A 44 year old man sustained a fracture involving both the frontal and the ethmoid sinuses, with loss of consciousness for twelve hours. Nine weeks after the accident, spinal fluid was seen coming from the right nostril, at which time gram-positive cocci were present in it. The patient was kept in a semisitting posture until the temperature and the meningeal signs disappeared. Then he was placed horizontally with the head immobilized in a Hanflig collar. He recovered and was at his regular work eighteen months later.

2. A 12 year old boy had a fracture extending into the frontal sinus, with loss of consciousness. Meningitis appeared eighteen hours later. The cultures of the spinal fluid were negative, but the pressure reached 280 and the cell count was 7,500 with 50 per cent polymorphonuclears. The patient was irrational. Treatment consisted of spinal punctures and the administration of sulfanilamide. Recovery ensued.

3. A 20 year old man had a skull fracture extending into the frontal sinus, with unconsciousness and discharge of spinal fluid from the nose, followed by meningitis seven days later. Nonhemolytic streptococci and pneumococci were isolated. The patient was irrational and comatose and had loss of vision. Despite spinal punctures, administration of sulfanilamide and transfusions, he died sixteen days after the accident. There was no autopsy.

4. A 48 year old man had a skull fracture involving the frontal sinus and the petrous bone; there were loss of consciousness and discharge of spinal fluid from the nose, and meningitis eleven days later. Spinal punctures and sulfanilamide brought about recovery, but the patient's headaches persisted.

6. A 20 year old man had a fracture involving both frontal sinuses, loss of consciousness, doubtful discharge of spinal fluid, and meningeal symptoms in forty-eight hours. There was an external wound, which was cleaned out and the dura exposed, revealing a laceration, which was not sutured. The convalescence was slow, but the patient was able to return to work several months later despite intermittent drainage from a sinus near the glabella.

255. Brody, B. S.: Cerebrospinal Fluid Fistula and Meningitis Secondary to Fracture of the Skull Involving the Paranasal Sinuses and Mastoids, J. Mt. Sinai Hosp. **5**:444 (Nov.) 1938.

7. There was a fracture through the right frontal bone and ethmoid sinus, with unconsciousness, followed by meningeal signs in seventy-two hours. The spinal fluid pressure was 300; there were 2,400 cells, 90 per cent of which were polymorphonuclears. Treatment consisted of frequent spinal punctures and transfusions. The patient died nine days later. Autopsy disclosed diffuse suppurative meningitis, and a fracture of the right supraorbital plate, extending into the ethmoid sinus.

8. A 42 year old woman suffered a fracture involving both tables of the frontal sinus, with prolonged drainage of spinal fluid from the nose and meningitis in twenty-four hours. The spinal fluid became purulent in a short time and contained streptococci. The patient died within forty-eight hours. There was no autopsy.

9. A 41 year old man had a compound fracture of the frontal bone involving both tables, with loss of consciousness, nasal hemorrhage and doubtful discharge of spinal fluid. Coma ensued very early. The wound was exposed, but no laceration was found in the dura. Death occurred in four days. Autopsy revealed basilar meningitis, a fracture of the frontal bone and cribriform plate and lacerations of the dura at the base.

In 1 of the cases reported by Bonnet [256] the patient sustained a blow over the forehead in 1924 with very slight effects except a small depressed scar with a tiny persisting fistula. He had no complaints until fourteen years later, when he suddenly complained of a sensation as of a flame in his head. Four hours later there were swelling of the orbit, redness and swelling of the lids, chemosis and a sensation of deep fluctuation on palpation. Roentgenograms showed destruction of the supraorbital margin and cloudiness of the frontal, ethmoid and maxillary sinuses, and there was a discharge of pus from the middle meatus. Operation revealed that the frontal sinus was replaced by a large sequestrum. The bone was resected widely to the external orbital angle, revealing a large encysted abscess in the orbit. The patient recovered. In a second case reported by this author there was a history of a blow over the brow followed by nasal hemorrhage and swelling of the eye. Roentgen pictures showed a fracture of the roof of the orbit, and there was subcutaneous emphysema. Expectant treatment was followed, and the symptoms disappeared. The author, however, feels that the process may still make itself known through a secondary infection, which is likely to appear at any time.

In the case reported by Hutchinson [257] the fracture involved both nasal bones, the mandible, and the malar, ethmoid and petrous bones

256. Bonnet, P.: Fracture du sinus frontal, Bull. Soc. d'opht. de Paris **51**:83 (Jan.) 1939.

257. Hutchinson, C. A.: A Case of Severe Sinus Infection Following Trauma, J. Laryng. & Otol. **54**:406 (July) 1939.

and extended into the labyrinth. Primary emphysema of the face was followed by the appearance of fistulas below the eye, in the cheek and sublabially. The antrum was very dark, and diplopia was present. Local intervention was at first not advised, but three months later an operation was undertaken because of continued purulent discharge from a fistula. Both antrums were full of pus, the floor of the frontal sinus was sequestrated, and the lacrimal bone and lamina papyracea were "smashed to smithereens." Later the orbit was opened from below, and the antrum was found fractured in the region of the foramen; several sequestrums were removed. The author disputes the statement that roentgen films will not show a fracture of the petrous bone and presents a picture proving the contrary. He refers to Chausse's method of "anti-diffusion stereoscopic analysis," which shows the course of the fracture line distinctly. The objections to this procedure are that it includes only a small field, in which it is difficult to identify the landmarks, the apparatus is expensive, and the study requires a large number of exposures. The author discusses various methods of reducing fractures of the malar bone and expresses a preference for the Denker approach with trans-antral elevation of the fragments and packing to retain.

Nishiyama [258] reports 5 cases of fracture involving the sinuses, due to war injuries. In several of the cases foreign bodies in the form of shrapnel splinters and bullets were identified on roentgen examination and recoverd by operation. Infection was present in all of the cases, but recovery followed adequate drainage and removal of dead tissue and foreign bodies.

Jones [259] reports 2 cases of foreign body in the antrum. One of the foreign bodies was a broken-off head of a curet, which caused suppuration lasting two years before it was discovered. The other was a segment of a molar tooth in the antrum after an extraction. The author points out the importance of the dentist's having a full posterior-anterior projection in cases in which it is suspected that a root projects into the antrum, since the small dental films may fail to show the root.

In Takano's [260] case suppuration of an antrum followed extraction of a wisdom tooth three years previously and was found to be due to a broken-off portion of a metal prosthesis which blocked the alveolar fistula.

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258. Nishiyama, A.: Kriegsverletzungen der Nase und der Nasennebenhöhlen, Oto-rhino-laryng. **12**:476 (June) 1939.

259. Jones, W. I.: Foreign Objects in the Antrum of Highmore, Am. J. Orthodontics **25**:380 (April) 1939.

260. Takano, T.: Zufallig entdeckter Fremdkörper der Oberkieferhöhle, Oto-rhino-laryng. **11**:1013 (Nov.) 1938.

Abstracts from Current Literature

Ear

CARE OF MASTOID WOUNDS FOLLOWING OPERATION OF THE BRAIN. HAROLD G. TOBEY, Ann. Otol., Rhin. & Laryng. **48**:590 (Sept.) 1939.

Otitic abscess is classified as acute, subacute or chronic and differentiated according to whether it arises by direct extension from the petrous bone or by metastasis from the blood stream. The former type, developing by gradual extension and retrograde thrombosis, usually is a chronic encapsulated abscess. The metastatic type is an acute nonencapsulated abscess, often superficial, accompanied by varying encephalitis about the area. It causes the greater mortality because of the tendency toward meningitis and the need for early operation, before encapsulation can occur. Abscesses of the brain must be drained, but the proper time for drainage, the site of drainage and the method must be considered.

Time of Drainage.—It is best to wait for encapsulation, which usually occurs during the fourth or the fifth week but may occur earlier. If, however, during the acute stage there is high temperature, marked prostration, an increase in the cell count of the spinal fluid and signs of beginning meningitis, early operation may be necessary.

Site of Drainage.—If indications of intracranial involvement are present at primary mastoidectomy, thorough exposure of the dura in the middle and posterior fossae is necessary. This exposure is more necessary during secondary mastoidectomy necessitated by the onset of symptoms suggesting involvement of the brain with an unhealed mastoidectomy wound. With an acute or a chronic abscess developing after the mastoidectomy wound is healed, the point of election is through a clean area as nearly as possible over the site of the abscess.

Methods of Drainage.—MacEwen used simple evacuation for acute abscesses and for chronic encapsulated ones a decalcified chicken bone. Dandy advocated tapping the abscess and repeating the procedure if symptoms persist. LeMaitre advised gradual dilation of a tract from the cortex to the abscess. J. E. King made a wide exposure and unroofed the abscess with a deliberate herniation of the brain. Mosher used a wire basket drain. Gauze, rubber strips and rubber tubes have been used. The author seems to prefer the use of the diathermy knife to remove the cortex or a core of cortical tissue down to, and including a sufficient part of, the capsule. This is preceded by coagulation of the dura over the exposed area if possible twenty-four to forty-eight hours before attacking the abscess. This provides wide access to the abscess and aids introduction of the drainage material. The technic may be applied to cerebral or cerebellar abscesses and may be used through a mastoidectomy wound or outside this area. The drain should be sutured to the skin but not to the dura after the use of diathermy.

Postoperative Care.—Maintenance of adequate drainage is necessary. Rubber tubing is used, with gentle suction under direct vision. If wire baskets are used daily curettage of the inner surface is usually needed to keep up drainage. The duration of drainage varies with each patient, four weeks being average time, after which the suture may be removed and the drainage tube allowed to be gradually forced out. Irrigations are rather discouraged, and when they are used adequate provision for a return flow must be insured. Dressing must be done daily, preferably by the surgeon himself. Herniation of the brain may occur but can be overcome. If brain tissue becomes necrotic or strangulated it may be removed by scissors or diathermy.

Sometimes signs of pressure recur or continue, in which case an extension or another abscess must be looked for. Exploration with the encephaloscope or a

long bladed forceps may aid. Digital exploration has been used successfully but is rather frowned on.

If a cerebellar abscess is suspected lumbar puncture is dangerous, but in other cases puncture is helpful in reducing intracranial pressure. Hypertonic solutions are at times useful.

M. V. MILLER, Philadelphia.

HIGH TONE DEAFNESS FROM A NUTRITIONAL STANDPOINT. GRANT SELFRIDGE, Ann. Otol., Rhin. & Laryng. **48**:603 (Sept.) 1939.

The author follows up his previous paper (*Ann. Otol., Rhin. & Laryng.* **46**:93 [March] 1937) with further discussion of the vitamins. He studied 81 cases, 47 of nerve deafness and 34 of conductive deafness, determining the output of vitamin B_1 and of porphyrin in the urine, as well as the content of vitamin C in the blood. The output of vitamin B_1 was low in all. In several the output was 6 international units, the lowest being 4 international units. (The normal output is 20 to 35 international units.) The output of porphyrin was increased in about 50 per cent and appears to be the index for the use of nicotinic acid. He quotes other authorities on the body requirements: "The minimum daily B_1 intake necessary for the adult weighing 99 pounds is about 135 I. U., for one of 154 pounds approximately 280 I. U. and one of 198 pounds needs 500 I. U." In the treatment of neuritis in alcoholic addicts the minimum effective dose was 4 mg. daily (1,200 international units) of thiamine chloride; from 10 to 20 mg. (3,000 to 6,000 international units) gave more valuable results, and in some cases as much as 50 mg. (15,000 international units) has been given to secure improvement. Selfridge used 10 mg. (3,000 international units) six days per week for several weeks, according to the age of the patient and the amount of B_1 present in a twenty-four hour specimen of urine. As urinary output improves the dose can be reduced. Occasionally toxic symptoms (curare-like convulsions and herpes zoster), due to irritation of the peripheral nerve plates, may appear; they were noted in less than 1 per cent of the cases in this series. Selfridge advises that one should stop administration as soon as the patient begins to complain of intense burning pain in an unsuspected area.

It is pointed out that nicotinic acid or its amide is apparently necessary for the normal health of the mouth and intestine, the nervous system and the skin, since these are all impaired in pellagra and improved by the ingestion of nicotinic acid or its amide. It is felt that it must also be necessary for the muscles and probably for the liver and some other organs. Selfridge has been using nicotinic acid whether or not porphyrin is present. Porphyrin may be present in the urine continuously, but when it does occur it should be considered of some importance, even though the patient appears to be in perfect health.

Laboratory methods for the determination of thiamine chloride and porphyrin and histories and discussions of 7 cases are given.

M. V. MILLER, Philadelphia.

SYPHILIS OF THE EAR: A HISTOPATHOLOGIC STUDY. VICTOR GOODHILL, Ann. Otol., Rhin. & Laryng. **48**:676 (Sept.) 1939.

Histologic study was made of the temporal bones of 16 persons with syphilis, half of whom had acquired syphilis, the others being infants who had been infected in utero. As a result the author concludes that there is no specific type of loss of hearing associated with syphilis of the ear.

The following histopathologic changes were found constantly:

1. Productive periostitis producing fibrosis followed by ossification of the perilymphatic and endolymphatic channels. Malformations of the bony channels are also produced.
2. Bony abnormalities of the stapes, especially the foot plate.
3. Atrophy of the neuroepithelial elements of the labyrinth.

4. Lymphocytic infiltration of the cochlea and spiral ganglion (miliary gummas).

5. Vascular changes consisting of diapedesis in prenatal syphilis and obliterative endarteritis in acquired syphilis.

M. V. MILLER, Philadelphia.

THE EFFECTS OF AEROPLANE NOISE ON THE AUDITORY ACUITY OF AVIATORS: SOME PRELIMINARY REMARKS. E. D. DALZIEL DICKSON, A. U. G. EWING and T. S. LITTLER, J. Laryng. & Otol. **54**:531 (Sept.) 1939.

A survey of the literature disclosed no audiometric studies in the English language demonstrating the effect of airplane noise on hearing. It is well known, however, that it can affect hearing adversely. The pilot who wears no protective device invariably becomes markedly deaf. At first this deafness gradually wears off after a few hours, but constant flying without protection leads to permanent impairment of hearing.

In addition to the effect on the pilots, the noise produced by the airplane engines affects the hearing of the personnel engaged in testing and tuning multi-engined aircraft.

The subjects from whom the data were obtained gave no history of previous ear trouble. Several pilots who had many flying hours to their credit and who flew with no protective apparatus for the ears were examined with the audiometer and by use of the spoken voice. The most constant result was a definite dip in the curve at the frequency of 4,096 hertzian cycles and a less constant one was a dip at 8,196 cycles.

After remaining in flight in a twin-engined bomber for an hour without any protection to the ears, one of the authors made notes of the immediate effects of the noise on his auditory apparatus. Audiograms were taken within ten minutes of landing. The following points were noted: 1. The ear nearer the engine was the deafer. 2. Tinnitus was present in this ear, lasting nearly three hours and corresponding in pitch to about 4,000 hertzian waves. 3. The audiogram showed characteristic dips at 4,096 and 8,192 cycles. 4. Pari passu there is a loss by bone conduction corresponding to the loss of frequencies by air conduction. 5. Subjective recovery took place within an hour.

In a study of deafness caused by exposure to excessive noise from whatever source, Bauch found substantially the same results as the above. It is consistently found that traumatic deafness is in the frequency of C^5 (4,096 Hertz). While it is supposed that the tone which produces fatigue is of the same frequency as that which impairs hearing by excessive noise, an analysis of the noise of airplane engines makes this doubtful. In general such noises occur below the frequency of 700 hertzian cycles. On this basis it would appear that a low-pitched noise causes a high frequency deafness.

Various methods for protecting the ears were studied. These consisted of the use of cotton wool saturated with several waxy substances. They were of some benefit, but those who used a high altitude type of helmet with ear phones attached showed no loss for high tones.

LEJEUNE AND BAYON, New Orleans.

DISCUSSION ON THE OTOLOGIST'S PART IN THE INVESTIGATION OF BRAIN LESIONS. Proc. Roy. Soc. Med. **32**:1303 (Aug.) 1939.

Mr. Terence Cawthorne stressed the importance of a thorough testing of the functions of the eighth nerve in investigations of lesions of the brain. The conducting part of the auditory apparatus must be carefully examined and the cochlear function estimated by means of audiometer and monochord tests with the use of a masker. The investigation of the vestibular function should include estimation of spontaneous nystagmus, spontaneous past pointing, the balance and the caloric reactions. Careful evaluation of the findings is necessary in order to arrive at any accurate conclusions.

Dr. C. M. Hinds Howell cited histories of several cases illustrating the importance of accurate aural examination and of testing in attempts at diagnosis of intracranial conditions.

Dr. T. O. Howie gave an analytic summary of functional tests in 65 cases in which intracranial disease was proved to be present. It illustrates the importance of careful functional testing and evaluation of the results in attempts to diagnose such intracranial conditions.

Dr. H. Frey said he believed that the rotation tests of vestibular function are important, especially in the estimating of the hyperexcitability of the nervous system as a whole.

Mr. S. C. Suggit cited a case of cerebral tumor and reported the audiometer findings.

Mr. C. S. Hallpike drew attention to some of the inaccuracies of vestibular testing.

CAMPBELL, Philadelphia.

"CHRONIC ADHESIVE PROCESS" DEAFNESS OPERATED ON BY SOURDILLE'S PROCEDURE. C. A. HUTCHINSON, Proc. Roy. Soc. Med. **32**:1313 (Aug.) 1939.

The patient had deafness characteristic of the conductive type, and operations were performed between March and August of 1934. He had retained improvement of hearing for five years, and the tinnitus present before operation had completely disappeared. The operator had performed two other similar operations without success. He discussed to some extent his own views as well as those of Holmgren and Sourdille regarding the causes of failure of operation in such cases.

CAMPBELL, Philadelphia.

AURICULAR VERTIGO (MÉNIÈRE'S DISEASE). AUBRY, BOUCHET and OBRÉDANNE, Oto-rhino-laryng. internat. **23**:468 (Sept.) 1939.

This article is a continuation of a paper with the same title published in the August issue. Two types of operation, destruction of the labyrinth and section of the auditory nerve, are practiced for relief of auricular vertigo. The prime indications for operation are that the vertigo must be severe and persistent and that it must be resistant to all medical therapy. The conditions are classified as those of vertigo with otitic antecedents and those without previous aural inflammation. In the first group the otitis has long been extinct and the labyrinth becomes invaded by scar tissue, or, on the other hand, the irritation is higher in the endocranium, realizing the truncular syndrome, which is usually allied to pontocerebellar arachnoiditis. A precise examination of the cochlear and vestibular functions is necessary to determine the type of operation required. If the ear is deaf, a labyrinthine operation may be tried, the success of which will depend on the functional state of the vestibular apparatus: if the vestibular function is conserved, the operation will probably be successful; if the vestibular function is abolished, the eighth nerve should be resected. If the ear is not deaf, the labyrinthine operation will almost surely destroy the hearing; in such cases, a resection of the vestibular division of the nerve is to be chosen. In a patient who has not had a mastoid exenteration and in one who has had such exenteration but in whom the hearing in the opposite ear is compromised, section of the nerve is indicated. In the case of a patient with a mastoid exenteration in whom the hearing in the opposite ear is good, the choice of nerve section or labyrinthine operation may be left to the patient, as the latter operation is much simpler. But even in such cases partial resection of the nerve is preferable, because it preserves the hearing and permits investigation of the pontocerebellar region. For patients with the truncular syndrome, which frequently implies the presence of arachnoiditis, the labyrinthine operation is useless, and one must free the fossa of arachnoiditis and resect the nerve.

In cases of vertigo without otitic antecedents it is especially important to differentiate the variety of vertigo. The neuralgic form responds to conservative measures, such as medical therapy or, at need, decompression of the membranous

labyrinth. In cases of the neuritic form destructive operation on the labyrinth or resection of the vestibular nerve is necessary. In those of the truncular form the pontocerebellar region must be exposed and appropriate operation employed. The operative technic is described in detail.

The results obtained from a simple decompression of the labyrinth by uncapping the external semicircular canal were 70 per cent cures and 30 per cent failures without exaggeration of the vertigo. In 62 cases of intervention in the posterior fossa, there were 32 complete and 27 partial sections of the eighth nerve. The results obtained were the following: In cases of the pure Ménière's syndrome and in those of atypical syndromes without otitic antecedents, complete and rapid relief was secured; in those with otitic antecedents, relief was had in all cases in which arachnoiditis was not present and in 50 per cent of those with arachnoiditis. Relief of tinnitus was had in all cases of the pure syndrome; in the truncular and the postotitic form, the tinnitus remained unchanged in almost all cases. In 2 cases, in which tinnitus without vertigo was present, no relief was obtained. This type of the disease should not be operated on. The effect on the hearing in the 27 cases with partial resection of the nerve was conservation in 14, important amelioration in 8, diminution (high tones) in 4 and complete loss in 1. In the opinion of the authors the operation is simple and relatively short, the technic is easy and the consequences are benign, if the contraindications are borne in mind; the age of the patient should not exceed 65 years, and arterial hypertension, an otitic focus in evolution or a previous, acute meningeal episode is an absolute contraindication.

Various pathogenic theories have been expressed, but it is probable that no one theory can explain the condition in all cases and that each theory contains a part of the truth. Changes in the internal ear due to vascular changes or a modification of the tension of the labyrinthine fluids explain in a large number of cases the vertigo of the neuralgic type. Neuritic changes in the trunk of the nerve are the explanation in perhaps the greatest number, especially of the neuritic vertigos, while changes in the pontocerebellar lake explain the truncular type in practically all cases.

DENNIS, San Diego, Calif.

CLINICAL OBSERVATIONS OF OTITIC BRAIN ABSCESSES. W. KRAINZ, Monatschr. f. Ohrenh. **73**:599 (Sept.) 1939.

With 6 cases of otogenous cerebral abscess and 1 of cerebellar abscess on record, in only 4 of which the patient died, the author discusses the treatment of brain abscesses after operation. He assigns an important role to this after-treatment and advises that it should be carried out only by the best trained men. The after-treatment, which consists of keeping the exposed cavity well opened, is extended over several months and is based on the knowledge that an abscess cavity in the brain granulates slowly and if not properly kept open may soon form pockets and give rise to symptoms of retention. The question of the formation of a capsule is difficult to decide in vivo, although of considerable importance for the prognosis. The iodoform drain is changed daily, and the general condition of the patient is carefully controlled.

LEDERER, Chicago.

CONTRIBUTION TO THE KNOWLEDGE OF THE LOCALIZATION OF EARLY LESIONS OF THE COCHLEAR NERVE. G. E. ARNOLD, Monatschr. f. Ohrenh. **73**:606 (Sept.) 1939.

In a patient with botulism complicated by acute otitis media, Arnold found an acute disturbance of labyrinthine function combined with a decrease of hearing for high tones (c^5), established through audiometric examination; all of the acute symptoms subsided. The author cites examples from his own experience. In listening to concerts of long duration, he felt, he says, a ringing in his ears, occurring at levels somewhere between e^5 and f^5. This lasted for some time after the stimulating music had ended. (The communication closed here and is to be continued.)

LEDERER, Chicago.

Larynx

CARCINOMA OF LARYNX. E. WATSON-WILLIAMS, Proc. Roy. Soc. Med. **32**:1236 (Aug.) 1939.

This man of 56 years had a pedunculated polyp removed from a vocal cord which gave a clinical picture of chronic catarrhal laryngitis. The pathologic section suggested a papilloma which had become carcinomatous.

CAMPBELL, Philadelphia.

FRACTURE OF THE THYROID CARTILAGE. J. C. HOGG, Proc. Roy. Soc. Med. **32**:1237 (Aug.) 1939.

This patient received a severe blow across the larynx. Examination showed flapping of the cords on phonation; both thyroid alae were mobile, and crepitus could be felt. A vertical fracture of the thyroid cartilage had occurred, with the soft parts interposed between the fragments preventing fibrous union. The feasibility of suturing the perichondrium together to give more rigid cards was considered.

CAMPBELL, Philadelphia.

SEPSIS ORIGINATING FROM A GUMMA OF THE LARYNX. T. POLYANSZKY, Monatschr. f. Ohrenh. **73**:665 (Oct.) 1939.

The pathologic changes and clinical manifestations of tertiary syphilis of the larynx are discussed. A case is described in which antisyphilitic treatment was unsuccessful, so that the involvement of the epiglottis, the hyoid bone and the thyroid cartilage resulted in necrosis and finally led to the death of the patient. Surgical intervention was of no avail.

LEDERER, Chicago.

CYLINDROMA OF THE AIR PASSAGES. F. BOEMKE and W. MORITZ, Ztschr. f. Hals-, Nasen- u. Ohrenh. **45**:228, 1939.

The authors present a case of cylindroma of the trachea. The disease had rather a benign course, lasting over four years. The principal symptom was a unilateral recurrent nerve paralysis, which later became bilateral, with a resultant fixation of the cords in a paramedial position. Dyspnea was another symptom which occurred late. They describe at length the histologic appearance of this growth, and state the belief that it was an epithelial tumor, a type of lesion which, though benign, may infiltrate and eventually metastasize to the lungs, kidneys and other organs. The tumor was extirpated through a laryngofissure. Though there was a recurrence, a complete cure was effected by the secondary removal. High voltage roentgen therapy was given as a supplement to the surgical treatment.

PERSKY, Philadelphia.

Nose

CONGENITAL OCCLUSION OF THE POSTERIOR NASAL CHOANAE. D. B. KELLY, Brit. M. J. **1**:157 (Jan. 28) 1939.

Although rare, congenital occlusion of the posterior nasal choanae deserves consideration. In the newly born infant there is considerable difficulty of breathing, resulting in dyspnea and even cyanosis, and this is relieved only when the baby's mouth is opened as when crying. It is cyclic in its occurrence. Both sucking and nutrition are interfered with. Unilateral occurrence is rarely recognized in early life. Only when the patient is older does it come to the attention of the physician. Kelly thinks that the obstruction is caused by absorption of the bucconasal membrane. It may be either unilateral or bilateral. Its cause is considered a defect in embryonal development. A case is reported. The operative technic is outlined, and attention is drawn to the difficulty of keeping the artificial ostium made in the occluding bony plate open.

ROYSTER, University, Va. [AM. J. DIS. CHILD.]

DISCUSSION ON THE COMPLICATIONS OF INTRANASAL SURGERY. Proc. Roy. Soc. Med. **32**:1238 (Aug.) 1939.

Walter Howarth discussed the following procedures and conditions necessary in an attempt to prevent postoperative complications: adequate and careful anesthesia (both local and general), dry operative field, good illumination, correct diagnosis, absence of acute infections, good technic, proper time of operating and postoperative packing. He emphasized the importance of operating on sinuses by the external radical approach rather than by the intranasal route in those cases in which success depends largely on completeness of the surgical procedure.

Edward D. D. Davis called attention to the following possible injuries of structures adjacent to intranasal tissue: (1) perforations of and injuries to the roof of the nose or the cribriform plate, (2) injury to the orbit and its contents, (3) injury to the optic nerve and (4) injury to the nasolacrimal duct. He discussed the methods usually adopted by nasal surgeons to avoid such injuries as well as the treatment of these complications when they occur.

E. Musgrane Woodman called attention to the danger that may be associated with surgical procedure on the nasal septum at the same time operation on an infected sinus is performed, and to the danger of operating on the septum in the presence of abscesses of the upper incisor teeth. He said he believed that irrigation of the sphenoid sinus often results in accidents.

Douglas Guthrie advocated cleansing of the nose or sinuses and the use of antiseptics preliminary to intranasal operating.

W. S. Thacker-Neville emphasized the importance of careful and exact operative technic.

T. Ritchie Rodger advocated the avoidance of all packing after intranasal operations.

Herbert Tilley cited two accidents that had occurred during operations on the nose.

T. B. Jobson stated that he used gauze packing with mild protein silver in his antrotomy cases and had never had postoperative trouble.

CAMPBELL, Philadelphia.

Miscellaneous

CEVITAMIC (ASCORBIC) ACID DEFICIENCY. FREQUENCY IN A GROUP OF ONE HUNDRED UNSELECTED PATIENTS. JOSEPH D. CROFT and LOWELL D. SNORF, Am. J. M. Sc. **198**:403 (Sept.) 1939.

By the method of Farmer and Abt the concentration of ascorbic acid in the blood plasma was found to vary between 0.12 and 1.44 mg. per hundred cubic centimeters in a series of 100 unselected patients of a high average economic level. The arbitrary value of 0.40 mg. per hundred cubic centimeters was selected as the lower level of normal so that all values below this were regarded as evidence of deficiency. Of the 100 patients, 38 had a deficiency. Of these 38, 66 per cent had been following a diet lacking in vitamin C on account of gastrointestinal symptoms; 26 per cent gave a history suggestive of a diet lacking in this vitamin, while only 8 per cent had been receiving an adequate diet. Sixty-four per cent of the deficient group had caries, spongy gums or well developed gingival infections, while 13 per cent were edentulous and only 24 per cent had teeth and gums in good condition.

In the nondeficient group of 62 patients, only 8 per cent had been on a diet definitely deficient in vitamin C and 21 per cent on a suggestively deficient diet, while 71 per cent had been on adequate diets. Only 10 per cent had caries, spongy gums or gingival infection; 6 per cent were edentulous, while 84 per cent had teeth and gums in good condition.

The authors conclude that subclinical deficiency in vitamin C is a frequent occurrence even in people with the economic ability to obtain a balanced diet.

In no case were there spontaneous petechial hemorrhages or other evidence of scurvy other than the gingival sepsis and caries. However, 40 per cent of the deficient group were suffering from peptic ulcers, and nearly all of these (34 per cent of the deficient group) had had recent gastrointestinal hemorrhage. In the nondeficient group there were but 2 instances of recent gastrointestinal hemorrhage and 3 of ulcer. While the deficiency in vitamin C was probably the result of restricted diet in the cases of ulcer, the authors suggest that the apparent tendency to hemorrhage may be related to the deficiency, with weakening of the blood vessels.

SHAMBAUGH, Chicago.

HEARING ACUITY AND STAMMERING. M. ARLINE HARMS and J. Y. MALONE, Ann. Otol., Rhin. & Laryng. **48**:658 (Sept.) 1939.

It is estimated that at least 1,000,000 children have speech defects, a number which exceeds that of the crippled, blind and deaf combined. About 10 per cent of those with defective speech are stammerers. Speech is learned by hearing speech. Stammering is rare in cases of total deafness. Poor hearing causes distortion of words and uncertainty as to pronunciation and consequently a hesitancy in speech. Stammering becomes more frequent in those with around 50 per cent loss of hearing. Of 62 consecutive cases of stammerers who were unaware of any loss of hearing, a deficiency of hearing was found with the audiometer in from 10 per cent to 22 per cent, strongly suggesting a relation between loss of hearing and the development of stammering.

M. V. MILLER, Philadelphia.

OTITIS AND SINUSITIS IN THE SWIMMER. H. MARSHALL TAYLOR, J. A. M. A. **113**:891 (Sept. 2) 1939.

The author discusses the biologic approach to the study of the prevention of infections of the sinuses and the ear secondary to swimming. Questions of contamination of water, with a historical review, and opinions of sanitarians are entered into in moderate detail.

Emphasis is placed on the ability of aquatic animals to close the anterior nares, either voluntarily or involuntarily, during immersion in water, an adaptation entirely lacking in man. Man, therefore, is unable to protect the mucosa of the upper part of his respiratory tract.

Pictures show the nose of the manatee (Trichechus) open and closed, the nose of the hippopotamus open and closed, the blowhole of the porpoise open and closed, a diver demonstrating the correct method of breathing during swimming (exhaling through the nose while the head is submerged and inhaling through the mouth) and the ear of a seal (Phoca) opened and closed; the protective mechanisms of the aquatic animals are clearly illustrated.

The author summarizes his address by stating that in view of the modifications that aquatic animals have for their environment (closing the nose and ear during immersion in water and a means of maintaining the normal body temperature), which factors are not present in man, there is but one conclusion: that man is a terrestrial animal and that his structure and functions are not modified for an aquatic environment.

When out of his normal sphere, unless he takes cognizance of the limitations nature has placed on him and heeds the fundamental laws that regulate his being, he subjects himself to the likelihood of contracting the infections that frequently beset the swimmer. These nasal and aural involvements run the gamut of pathologic conditions from an innocent circumscribed furuncle to disease of the mastoid with all its intracranial complications, as well as fulminating infection of the sinuses and such complications as osteomyelitis of the frontal bone and intracranial lesions.

GORDON, Philadelphia.

THE CLINICAL IMPORTANCE OF INFECTION OF THE RESPIRATORY TRACT IN RHEUMATIC FEVER. T. DUCKETT JONES and JOHN R. MOTE, J. A. M. A. **113**:898 (Sept. 2) 1939.

The authors present a clinical study of 749 patients with rheumatic fever for approximately one year, from December 1934 to December 1935, but there are included some observations relating to infections of the respiratory tract and recurrences. They attempt to evaluate the importance of the infections in cases of rheumatic fever and especially the role of the hemolytic streptococcus in rheumatic and nonrheumatic infections.

The study is detailed. Several charts accompany the article. The conclusions and observations are summarized as follows: A close relation exists between acute infections of the upper respiratory tract and the first attacks of rheumatic fever, as well as recurrent rheumatic fever. Infections of the respiratory tract preceded 58 per cent of the first attacks of rheumatic fever, and of these precipitating infections two thirds were symptomatic sore throat. In the inactive stage of rheumatic fever, sore throats and colds precipitate recurrent rheumatic fever. The chance of a recurrence subsequent to an infection of the respiratory tract decreases as the period of the inactive phase of the disease increases. Of 271 observed recurrences of rheumatic fever, two thirds were clinically associated with infections of the respiratory tract; the remaining third were spontaneous. There is strong serologic evidence that recurrences are usually associated with infection with the hemolytic streptococcus.

GORDON, Philadelphia.

ABNORMAL MOVEMENTS FOLLOWING INJURY TO THE FACIAL NERVE. E. P. FOWLER JR., J. A. M. A. **113**:1003 (Sept. 9) 1939.

The author discusses the problem of abnormal movements of the face following recovery from toxic neuritis of the facial nerve and from traumatic lesions of that nerve.

He has had a great deal of experience in this special field and has worked with two of the outstanding clinicians in certain of its phases, the late Dr. Arthur B. Duel and the late Sir Charles Ballance. The article is thorough and contains some diagrams, photographs and slides.

By careful analysis, observation and experiments he reaches the following conclusions: 1. Associated movements of the various parts of the face occur after recovery with all severe injuries to the facial nerve. 2. Ticlike movements occur in patients with healed palsy of the facial nerve of traumatic origin if they blink their eyes a great deal or have mobile faces. 3. The associated movements and facial spasms occasionally follow paralysis of the facial nerve of toxic origin. 4. Both these phenomena are caused by the splitting of axons in the neuroma which invariably forms at a point of severe injury, whether toxic or traumatic. There is consequent enervation of several parts of the face by neurofibrils from a single axon. 5. These phenomena are not caused by improper rerouting of nerve bundles because, when this is done experimentally, reeducation takes place so that associated movement or ticlike movement does not occur. 6. These phenomena are not central in origin. 7. The ticlike movements are pathognomonic of a peripheral injury to the nerve, and if they occur one can be sure that there has been trauma or severe toxic disturbance of the nerve. 8. Every effort should be made to relieve peripheral palsy of the nerve as early as possible so as to forestall serious damage to the nerve and subsequent production of abnormal movement.

GORDON, Philadelphia.

A THYRATRON INFLECTOR, ITS BEHAVIOR WITH CERTAIN VOWELS AND ITS USE IN INSTRUCTING DEAF CHILDREN. TIKVAH ALPER STERNE and H. J. ZIMMERMAN, Laryngoscope **49**:708 (Aug.) 1939.

Sterne and Zimmerman describe the construction and use of a thyratron inflector to assist in the instruction of deaf children in voice production and

control. The apparatus has a vertical row of lights arranged to flash in accordance with the fundamental pitch of the voice—the higher the pitch, the greater the number of lights which respond. Voice and the inflection of the voice are thus translated into visual symbols, to the great benefit of the deaf child, who ordinarily, being unable to hear his own voice, frequently pitches it badly and has to rely on his kinesthetic sensations for the determination of pitch.

The authors review the history of education of the deaf by instruments which translate sound into light impulses; they analyze the characteristics of vowel sounds, and review the theories of vowel production and relation of pitch to vowel sounds. The construction of the inflection indicator is described as an adaptation of Hunt's electronic frequency meter circuit with thyratrons. Included are an output meter to indicate the intensity of the voice and a loud speaker to enable the child to feel the vibrations due to a sound while he is watching the lights.

Sterne found that correct inflection in words and phrases cannot be taught until the child is able to place any speech sound at any desired pitch. The child is shown how to keep a certain number of lamps glowing steadily while a sound is being phonated; he then practices until he is able to do it. The children, guided partly by the tactile sensations from their fingers on the loudspeaker, develop kinesthetic memory for the pitch that causes any lamp to glow. Practice is given in phonating the vowels at specific pitch levels.

It is advised that young deaf children be trained with the inflection indicator to learn at an early age to inflect their voices within the narrow range used in ordinary speech.

Wood, Newark, N. J.

Evaluation of Therapy in Trigeminal Neuralgia: Results of Treatment with Typhoid Vaccine in Eighteen Cases. E. R. Schmidt and J. M. Sullivan, Wisconsin M. J. **38**:635 (Aug.) 1939.

In evaluating the results of treatment of trigeminal neuralgia with hyperpyrexia, Schmidt and Sullivan chose typhoid vaccine because of its ease of administration and handling, treating 18 patients. Injections at about biweekly intervals, starting with a dose of 10,000,000 killed organisms, were given intravenously, and the doses were stepped up by 10,000,000 or 20,000,000 each time until a good thermal reaction was obtained. Early in their series they learned that results could be obtained as readily with a mild as with a high thermal reaction. The majority of their patients were hospitalized for their treatments, but several ambulatory patients were treated and no ill effects were encountered. Five patients obtained more than 80 per cent relief and were satisfied to control their residual tic with mild analgesics or Christian fortitude rather than to submit to further therapy. In 5 other patients, relief was complete and continuous. Four patients experienced complete relief for from two to four months and failed to respond to a second course of vaccine therapy, so that injections of alcohol were necessary for the further control of the tic. Three patients obtained 50 per cent relief or less and needed injections of alcohol to complete their treatment. Only 1 patient in the series failed to show some amelioration of symptoms after vaccine therapy; the sensory root of the trigeminal nerve was resected, and complete relief ensued. Women showed a slightly better response than men to this form of treatment. The use of snake venom in a trial group proved unsuccessful in relieving pain of this type.

J. A. M. A.

Clinical Problem of Migraine in Children. A. Oliveira Lima, Brasil-med. **53**:765 (July 29) 1939.

According to Oliveira Lima, allergy is the main etiologic factor producing migraine in children. Of secondary importance are heredity and constitutional physical factors, or pathologic factors. The condition is more frequent in girls than in boys and is more frequent in girls of a nervous type than in normal girls. The clinical symptoms are those of the prodromal and aural periods, the attack

and the after-attack period. The topographic pattern, acuteness and evolution of the disease vary in the different cases. The main symptom of the attack is the unilateral headache, which appears at regular or irregular intervals with pain of oppressive, irradiating or neuralgic type and is accompanied by nausea, vomiting and various sensory disturbances. Intolerance to light is more or less acute in all cases. The after-attack stage gradually establishes itself, after aggravation of the acute symptoms of the attack. It becomes evident by appearance of physical depression, sleep, disturbances in the secretion and elimination of urine, rhinorrhea and general dull pain. In some cases the development of an abortive or equivalent attack prevents occurrence of typical attacks. Chronic headache may be a late sequel of the disease. Treatments are of three types: (1) preventive, (2) symptomatic and (3) after-attack. There are two forms of preventive treatment: that in which patients are advised not to marry persons who are sensitive to the same allergens, and the actual preventive treatment of the patient, which includes proper diet and avoidance of food and ambient allergens to which the patient is sensitive. Symptomatic treatment varies with the type of headache. The following general measures are indicated: The patient is confined to a dark, quiet room, and drugs with a vasodilating action are administered during the prodromal and aural stages; during the attack, according to indications, drugs of vasoconstrictive action, or else analgesics, sedative drugs and especially ergotamine tartrate, are given. Caffeine, calcium and some other drugs can be resorted to when indicated. The after-attack treatment is a continuation of the symptomatic treatment with certain modifications. It consists of the proper diet, rest and administration of either sedatives or stimulants, according to indications.

J. A. M. A.

TEMPERATURE OF THE NASAL MUCOSA. P. MONTI and F. VENTURA-GREGORINA, Arch. ital. di otol. **51**:389 (Aug.) 1939.

The material used in this investigation comprised 87 subjects: 37 with normal nasal mucosa and 32 with hypotrophic and 18 with hypertrophic changes. Forty-nine of the subjects were examined in winter and 38 in summer. The thermoelectric couple apparatus of Benedict and Comel was employed, and observations of temperature were made in the sphenopalatine recess, the middle meatus and the infundibulum. The investigation revealed, first, that the data obtained were much superior to those of the cutaneous picture, which demonstrates the efficiency of the thermic tonus of the nasal mucosa. Second, a constant thermic tonus in the various seasons is maintained by the regulatory mechanism. The increase of temperature noted in winter in those with mucosal hypertrophy is explained by a state of vasodilatation, provoked by the colder air inspired, which fact supports the hypothesis that climatic elements favor congestive and inflammatory conditions. In most of the subjects examined the nasal respiratory capacity was taken into account, and it was noted that the greater the ventilation the lower was the temperature of the mucosa. The measurements of temperature revealed a fundamental constancy and almost perfect symmetry of the nasal thermic picture, which represents one of the aspects of caloric equilibrium in warm-blooded animals. One of the principal factors in the nasal function of warming the inspired air is the blood flow, regulated by the complex neurovegetative vasomotor mechanism.

DENNIS, San Diego, Calif.

Society Transactions

MONTREAL MEDICO-CHIRURGICAL SOCIETY, SECTION OF OTOLARYNGOLOGY

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Dec. 13, 1939

Hematoma of the Facial Nerve Following Simple Mastoidectomy; Decompression of the Facial Nerve with Gradual Recovery of Function. Presented by Dr. A. O. Freedman.

A youth aged 19 was admitted to the Jewish General Hospital on March 17, 1939, complaining of a purulent discharge from his right ear and a vague feeling of discomfort around that ear. He had been well until about three weeks previous to admission, when he had an attack of the "grip." At this time his temperature was 103 F. A week later he had pain in the right ear and spontaneous bloody discharge, which later became purulent. The discharge and discomfort in the ear persisted. There was a history of both ears having been lanced when the patient was a child. The tonsils and adenoids had been removed. There was no history of frequent colds or of any sinus disease.

On admission the patient appeared well nourished, well developed and comfortable. The temperature was 99 F. The pulse rate was 80. The left ear drum was normal in appearance, except for an old scar in the posterior inferior quadrant. The canal of the right ear was filled with thick purulent discharge and was narrowed. There was sagging of the posterior upper wall. This prevented visualization of the drum. There was slight tenderness of the mastoid on firm pressure. A roentgenogram revealed a sclerotic mastoid, with breaking down and cloudiness of cells in the region of the antrum. The white blood cell count was 12,000 per cubic millimeter, and the hemoglobin amounted to 80 per cent.

Simple mastoidectomy was done on March 18. The usual incision was made behind the right ear. The cortex was hard and sclerotic. The lateral sinus was placed forward, so that only a narrow space existed between the lateral sinus and the posterior bony meatal wall. This region was filled with necrotic material, which was curetted away. Near the antral region there was a gush of thick yellow pus, probably from the region between the skin and the bony wall of the external auditory meatus in the region of the aditus. Considerable difficulty was encountered in locating the aditus. It was found deep down and high up near the tegmen. Only a small opening was present. After the narrow mastoid cavity was curetted, a soft necrotic spot was seen in the upper portion of the posterior bony wall at about the level occupied by the vertical portion of the facial nerve. This spot was only lightly curetted. The wound was lightly packed with iodoform dressings. Two sutures were inserted.

Twenty-four hours after the operation there was complete paralysis of the right side of the face. There was some movement in the eyelids but none around the mouth. Taste was markedly impaired on the right side of the tongue anteriorly to salt, sugar and pepper. Stimulation with the faradic current produced a slight response from the orbicularis oculi muscle but almost no response from the middle and lower branches of the facial nerve. After a lapse of two weeks,

during which no improvement appeared in the facial palsy and the profuse purulent discharge continued from the narrowed external bony canal, it was deemed advisable to do a radical mastoidectory to relieve possible pressure on the horizontal portion of the facial nerve.

Radical mastoidectomy was performed on April 2. The old mastoid wound was opened. The posterior bony wall was leveled down toward the tegmen. The lumen of the bony external meatus was found to be extremely small, about half the normal size. Where the middle ear was connected with the mastoid cavity, there were found two pockets of pus and granulation tissue, one under the superior part of the lateral sinus and the other adjacent to the tegmen. These cavities were cleaned out. The middle ear cavity was small. Again, as in the previous operation, a soft spot was noted in the bone in the middle portion of the descending part of the facial nerve. Because of the fact that there had been so much retention in the tympanic space, it was presumed that the facial palsy was due to neuritis along the horizontal portion of the nerve, and it was deemed advisable to leave this soft spot alone. With all cavities thrown widely open, it was assumed that this necrotic area would slough away. The wound was left wide open, and a plastic operation was not done. The wound was lightly packed with iodoform dressings. After twelve days there was no improvement in the palsy.

Decompression of the facial nerve was done on April 14. The wound was opened widely. The granulation tissue in the mastoid cavity and middle ear was curetted out. By means of a curet, starting from the soft spot in the facial ridge noted in two previous operations, the facial nerve was followed down toward the tip and upward around and under the horizontal canal. At about 0.5 cm. below the junction of the horizontal and vertical portions of the facial nerve, a bulbous swelling, about 4 by 3 mm., was found on the nerve. This swelling was deep bluish black, in contrast to the white glistening nerve at either end. It was considered to be a thrombosis due to a small hemorrhage between the sheath and the nerve proper. The sheath was incised in this region, and a small blood clot was gently removed. The wound was then lightly packed and left wide open.

Plastic repair of the mastoid was done on April 26. The boundaries of the wound were freshened up by means of a curet. A Neumann triangular plastic flap was fashioned from the external meatus. The wound in the skin behind was sutured.

The patient was discharged from the hospital on May 3, without any improvement in the palsy. From May 3 till about October 1 he received weekly stimulation to the facial muscles with the galvanic current. He also massaged the muscles of his face daily and wore a supporting hook to the angle of the mouth at night. There was little if any improvement for the six months following the initial paralysis. It is only during the past month that the patient has shown any marked improvement, particularly of the upper branches and to a lesser extent of the middle and lower branches of the nerve.

DISCUSSION

DR. KEITH HUTCHISON: Dr. Freedman has described an interesting clinical experience. In opening the discussion I might say that those who practice otology are gradually coming to face the problem of facial paralysis with more confidence than they did five or six years ago. The technic of decompression is one which all are competent to follow, and it seems to me that the problem is to decide when the operation should be done. I had 2 cases of facial paralysis in the wards recently, in both of which splendid recoveries are being made without treatment. That fact, coupled with experience in other cases, leads one to believe that the facial nerve is a fairly resistant structure. It stand up under a great deal of handling and has shown good recuperative powers, as the case of Dr. Freedman illustrates. His plan is the correct one. When paralysis makes its appearance at unforeseen stages in the course of the disease, it is my feeling that it should be watched care-

fully and that nature should be given a reasonable chance to control it before decompression is undertaken. Just how long one should wait is possibly open to some argument. Certainly I suggest that three weeks is the outside limit in a case of definite facial paralysis coming on after operation without any sign of recovery; then I feel that one is justified in performing decompression. Dr. Freedman did not wait so long, but that, of course, is a matter of personal opinion. The period of recovery is about six months, I believe. That is the ordinary time it takes a damaged nerve to regenerate—from one hundred and seventy to one hundred and eighty days. There is some satisfaction in the fact that the problem of facial paralysis in the field of otology is generally clearing; all otologists have a more definite knowledge of what it is and how to handle it, and I think no hesitation should be shown in doing what Dr. Freedman did. The procedure is to lay the nerve bare and cut a slit in the sheath. This gives the nerve a chance to breathe. Of course, if the nerve is definitely cut across, then the scene is set for a nerve graft.

Dr. James T. Rogers: In every case of facial paralysis following radical operation one has to be careful in deciding whether the paralysis is the immediate result of the operative procedure or whether it is due to some other cause, such as ordinary Bell's palsy. I am reminded of a case of mine in which complete facial paralysis appeared two days after a radical mastoid operation. Fortunately for my peace of mind the paralysis appeared on the side opposite to that of the operation. Had the paralysis occurred on the same side as the operation I would have been faced with the more difficult problem of deciding just what was the etiologic factor. Unnecessary surgical measures might have been undertaken for its relief.

The lapse of time, as Dr. Hutchison said, is a safe criterion to follow to see what, if any, improvement may take place. If no further improvement takes place, how long would Dr. Freedman allow this patient to go on before doing an anastomosis?

Dr. W. J. McNally: It is interesting to note that 2 patients were recently brought into the Neurological Institute with head injuries and skull fractures, and in each case there were suppuration from one ear and facial paralysis on the side of the otitis. In each case a simple mastoid operation was done to avoid the danger of meningitis and, it was hoped, to improve the condition of the facial nerve. Both patients were given sulfanilamide and sulfapyridine. In about two weeks from the time of injury or operation there was no meningitis, the mastoid wounds were healing well and the external auditory canals and the facial paralysis were healed. Even in cases in which this condition follows fractures it is worth while waiting two or three weeks.

Dr. A. O. Freedman: In answer to Dr. Rogers, the question of anastomosis of the nerve hardly enters into the discussion as to the future management of the case. The third operation, exposure of the facial nerve, revealed the cause of the palsy, a hematoma along the course of the nerve. There was no breach of continuity of the nerve.

The brief synopsis of the care and management of the patient does not convey the difficulties and worries which the case presented. The first difficulty was encountered when I saw the patient for the first time, twenty-four hours after the operation, with complete facial palsy; neither members of the nursing staff nor the intern could tell me precisely whether the palsy was present immediately after the patient came out of the anesthesia or appeared on the following morning.

Another disturbing factor was the great difficulty I had in locating the aditus during the first operation.

The soft spot in the mastoid bone near the posterior bony meatal wall, discovered at the first operation, worried me. I had a feeling that it communicated with the bony facial canal. Yet neither at the time of the first operation nor at the time when I did the radical mastoidectomy did I consider it wise to explore it to the limit, for fear of injuring the nerve. It was only when I did the third

operation, with the object of exposing the whole nerve and seeing where the drainage was, that I found the hematoma on the nerve at the bottom of this soft spot.

In retrospect, I have come to the conclusion that the sequence of events leading to the hematoma was as follows: (1) a hard sclerotic mastoid, (2) a dehiscence in the bony facial canal communicating with the diseased mastoid cells (soft spot) and (3) pressure necrosis from use of hammer and gouge, causing a localized injury to the accompanying vein in the bony facial canal.

Tearing of the eye on the paralyzed side was a troublesome symptom for many months.

The patient now has almost complete recovery of all three branches of the nerve. The ear has been dry for nearly five months. He has over 50 per cent hearing left in the ear which was operated on.

Retrobulbar Neuritis and Atrophy of the Optic Nerve Treated by Sphenoidotomy. Presented by DR. R. P. WRIGHT.

A. S., a man aged 53, was referred to the otologic clinic from the ophthalmologic clinic with a diagnosis of atrophy of the optic nerve of the right eye. He had ptosis of the right upper eyelid and diminishing vision in the left eye. A diagnosis of hyperplastic ethmoiditis and sphenoiditis was made, and the patient was admitted to the otologic ward on Feb. 23, 1921. He complained of pain over the region of the left temple and in the top of the head and numbness of the right cheek bone and jaw. The right eye was sensitive, and his vision was failing. The family history was not significant. He had blood poisoning due to a mosquito bite thirteen years previously. He had typhoid fever ten years previously and again three years later. The patient came to Canada from England thirteen years ago and was then admitted to the Winnipeg General Hospital with pain in the right eye, diplopia and bilateral ptosis. He had paralysis of the sixth nerve and defective vision in both eyes. He recovered completely from this attack but had succeeding attacks associated with numbness of the right side of the face and the right side of the tongue. He had all his teeth extracted, with little relief. Five months before admission he became worse.

On admission vision in the left eye was 6/18. Vision in the right eye was limited to counting fingers at 2 inches (5 cm.). There was ptosis of the right eye. The right pupil was contracted. In the nose there was a septal deviation to the right. The right middle turbinate was hyperplastic, and there was chronic hyperplastic ethmoiditis and sphenoiditis. The tongue protruded to the left, and sensation was impaired on the right side. The taste was impaired. There was difficulty in whistling. The roentgenograms showed the frontal sinus to be small and heavily blurred; both ethmoid sinuses and the left antrum were hazy. The other sinuses were clear.

On February 26, under intratracheal anesthesia, the high septal deviation was corrected. The right middle turbinate was removed, and the labyrinth of the ethmoid bone was opened. The ostium sphenoidale was exposed. Both nares were packed with plain gauze soaked with alkaline solution. On March 8 the ostium sphenoidale was enlarged with a chisel and mallet, and the anterior wall was removed. Thickened mucosa was curretted from the sphenoid sinus. A light gauze packing was applied. On March 11 the patient was transferred to the medical ward suffering from lobar pneumonia. He was discharged from the hospital on May 10. His sight had returned to normal in the left eye and had improved in the right.

On Aug. 12, 1930, he was again admitted to the ophthalmologic service for ptosis of the right eyelid. A Matois operation was performed. On July 6, 1932, he was again admitted to the medical ward (Dr. Howard), with a provisional diagnosis of typhoid fever. The final diagnosis was acute sinusitis with ptosis of the right eyelid and partial facial paralysis on the right side, atrophy of the right optic nerve and central scotoma. The Wassermann reaction was again negative. The roentgenogram showed cloudiness of the left antrum, suggestive of acute congestive change or chronic infection of the mucoperiosteum.

On July 20 iodized poppyseed oil showed filling defects in each antrum. Radical antrotomy was advised but refused. The following statement was made on July 21 by Dr. McKee: "Right disk palish, with a central scotoma indicating local involvement of the nerve (retrobulbar rather than central). Cause probably local (such as sinusitis); this probably caused the ptosis as well."

In November 1939 the eyes were again examined by Dr. McKee. Vision in the left eye was normal with correction, and fingers were seen by the right at 2 feet (60 cm.).

DISCUSSION

DR. S. HANFORD MCKEE: When Onodi, in 1908, described the anatomic relation between the posterior sinuses and the optic canal, he felt that he had definitely established an etiologic relation between disturbances of vision and disease of the posterior sinuses. Loeb a year later corroborated Onodi's work, and in 1920 Schaffer emphasized this relation. They all showed that it was not uncommon for the posterior ethmoid cells at the posterior external angle of the ethmoid capsule to encroach on the optic canal, making it abnormally small, a condition which may lead to serious pressure on the nerve, with subsequent pathologic changes.

In 1927 Crane expressed the opinion that not only was there a likelihood of direct extension of infection from this relation but that simple inflammation of the sinuses was sufficient to cause disturbance in the nerve. There are many different views as regards the method of extension of the infection. White in 1928, just shortly before his death, expressed the belief that the invasion of the optic nerve was always hematogenous and that he had never observed a case, except instances of malignant disease, in which he thought there was direct extension from the sinuses to the optic nerve. His theory of negative pressure is familiar. In 1934 Lillie, of the Mayo Clinic, stressed the unimportance of sinus infection as a cause of disturbance in the optic nerve. In only 1 of 225 cases of retrobulbar and optic neuritis was the condition due to sinusitis. Multiple sclerosis was by far the commonest cause in this series. Benedict concurred in this view of the importance of multiple sclerosis. Numerous others have made similar reports, and now multiple sclerosis has the center of the stage. Collins never agreed to the close relation of sinus disease and retrobulbar neuritis, and in 1928, when this theory was about at its height in the United States, he said that he had not yet seen a case in which retrobulbar neuritis could be attributed to sinus disease.

I should like to add to the discussion a case of papillitis associated with sinus disease.

A. Z., a man aged 41, was seen in the medical outpatient department and complained of impaired vision in the left eye, which had begun eight days previously. During the last three days, the sight in the eye had become practically nonexistent. Physical examination did not reveal much except the defective vision and tenderness over the left antrum and frontal sinus. The pupils reacted well to light, in accommodation and concentrically. The left optic disk was swollen about 3 D. The right eye soon became involved, and the vision became so defective that the patient could only count fingers. The right disk was swollen to about 4 D. and the left to 3 D.

The patient was referred to the department of otolaryngology, and after examination was operated on in that department by Dr. Hodge. A submucous resection of the nasal septum was first done. Five days later a radical operation on the frontal sinus and ethmoidectomy were done, with drainage of the sphenoid sinus. Little was discovered in the posterior sinuses at operation, though mucopus flowed out of the open right sphenoid sinus. The opening was enlarged, and the cavity was well drained with suction. Four days later distinct improvement had taken place in each disk. The patient's vision steadily improved. Three weeks later the sight in each eye was 6/12, and on examination later in the outpatient department he showed still further improvement and normal vision in each eye.

DR. DONALD MCEACHERN: The patient of Dr. Wright's shows involvement of certain other cranial nerves in addition to optic neuritis. This could be explained on the basis of periostitis surrounding the superior orbital fissure. As a neurolo-

gist, I look on the condition of uncomplicated retrobulbar neuritis somewhat differently. It often occurs as the first and only symptom of disseminated sclerosis; it may clear away and be followed months or years later by evidences of multiple lesions elsewhere in the nervous system. In the absence of any history or signs pointing to multiple lesions in the nervous system, one cannot, of course, condemn the patient with retrobulbar neuritis to a diagnosis of disseminated sclerosis. The natural history of retrobulbar neuritis is that vision fails rapidly and recovers rapidly in days or weeks. One must be cautious, therefore, in attributing to a sinus operation what may have been but normal rapid recovery. Of my last 7 patients with uncomplicated retrobulbar neuritis, none showed involvement of the sinuses clinically or roentgenologically. The sinuses were opened in 2 cases. Rapid improvement of vision occurred in all patients.

Watkins (Watkins, A. L.: The Cerebrospinal Fluid in Cases of Optic Neuritis, "Toxic Amblyopia" and Tumors Producing Central Scotomas, *Arch. Neurol. & Psychiat.* **41**:418 [Feb.] 1939), who followed cases of retrobulbar neuritis for three years, showed that disseminated sclerosis could be recognized in 50 per cent of cases before, during or after the occurrence of retrobulbar neuritis. Dr. Madelaine Brown, who discussed Watkins' paper, felt that a patient with uncomplicated retrobulbar neuritis had between 10 and 30 per cent chance of having disseminated sclerosis later.

Dr. James T. Rogers: Retrobulbar neuritis is a condition which intimately concerns both rhinologists and ophthalmologists. While they may not be entirely in agreement as regards the cause and treatment, still active cooperation between the two is essential for the proper diagnosis and cure of the disease.

Most patients with retrobulbar neuritis present so few nasal symptoms that the ophthalmologist is nearly always first consulted. Recognizing the possible seat of the trouble in the sinuses, he refers the patient to the rhinologist. The nasal symptoms are slight, but I think it is important to remember that there is nearly always a history of a cold or infection of the upper respiratory tract, which may have disappeared or which may still be present. The onset of sudden blindness, coupled with tenderness on pressure over the eyeball and pain on movement of the eyeball, about sum up all the symptoms.

Examination of the nose and sinuses reveals little or nothing of a pathologic nature, and were it not for the ophthalmologist's report of blindness with central scotoma, one would be inclined to dismiss the patient.

In a typical case retrobulbar neuritis develops as a rule not in the presence of a frankly purulent sinus but rather in association with those hyperplastic conditions so well described by Sluder, in which there is little or no sign of any infection. Of the various theories proposed to explain the condition, that of compression of the nerve in the optic canal seems to me not the least plausible. Roentgenographic studies of the optic canal by White and others have clearly demonstrated that in cases of retrobulbar neuritis the canal is definitely smaller in both its diameters. I was glad to hear Dr. McKee mention the researches of Onodi on the sphenoid and ethmoid sinuses, showing their close relation to the nerve. Sluder's work along similar lines also showed that in some cases the wall separating the optic nerve from the sinus was extremely thin, at times represented merely by mucous membrane. This is an important fact to remember in surgical treatment of this condition. Critics of the rhinogenic origin of retrobulbar neuritis cite its infrequency in children, although they are frequently the subjects of sinusitis. It must be remembered that the optic canal in children over 3 years of age is as large as in the adult and that therefore the nerve, having relatively more space, is less liable to compression. As regards treatment in the presence of retrobulbar neuritis, the first essential is to exclude any other etiologic factor, especially multiple sclerosis.

Not all conditions are to be treated surgically. Many patients recover spontaneously, and some others recover by conservative measures. But when there is steady and progressive loss of vision, despite treatment, then recourse to surgical

treatment must be made, as the longer operative measures are delayed the greater the danger of permanent atrophy to the optic nerve. From a study of a great number of cases of retrobulbar neuritis and the prompt, and at times dramatic, recovery which follows surgical drainage of the sinuses, I cannot help but feel that there is a definite causal relation between sinus disease and retrobulbar neuritis.

Dr. William J. McNally: Is it possible that the operation increases the blood supply and thus affects the nerve?

Dr. James T. Rogers: In answer to Dr. McNally's question, I cannot believe that the beneficial result is due to engorgement with blood after the operation. But I agree with Dr. McEachern's statement that if he had a patient with failing vision and cloudy sinuses he would have the sinuses drained, and I should also go a step further and advise surgical intervention in those cases, even if the roentgenograms showed clear or normal sinuses.

Dr. D. H. Ballon: I had a case of bilateral retrobulbar neuritis. One side was first involved. The roentgenograms of the sinuses were normal. Nasal examination gave negative results. The sphenoid sinus was opened. Nothing abnormal was found, and vision was recovered. A short time later neuritis developed on the other side. There was no operation, and the patient's vision returned to normal.

Dr. E. R. Stuart: I recently saw a man aged 54 who complained of failing vision for three months. A large stoma was found in one eye by Dr. Gordon Byers. A few nasal polypi were present in the middle meatus of the affected side. The roentgenograms of the sinuses were reported as normal. An external operation on the frontal, ethmoid and sphenoid sinuses was performed. The anterior ethmoid sinuses contained polypi. The posterior ethmoid cells were clear. The mucosa of the sphenoid sinus was thickened on the lateral wall. A biopsy specimen was taken from this, and a histologic diagnosis of squamous cell carcinoma was reported.

The lesion has been treated by radium, with considerable improvement in sight. I think this case should stand as a strong argument in support of sphenoidectomy in cases of retrobulbar neuritis of indefinite origin.

Dr. G. E. Tremble: Has Dr. McEachern seen any patients in whom impairment of sight recovered spontaneously without operation and then recurred as sclerosis progressed?

Dr. Donald McEachern: I have stressed the natural history of acute retrobulbar neuritis because I feel that recovery frequently occurs without any operative intervention. There may be a recurrence of optic neuritis when there is a flare-up of disseminated sclerosis. For example, a patient under my care at present had optic neuritis and other acute signs of disseminated sclerosis five years ago. The condition cleared up entirely. This summer the whole syndrome occurred again, and the patient is practically blind as well as paralyzed in both legs. Remissions and recurrences are, of course, characteristic of disseminated sclerosis. If infection of the nasal sinuses can be demonstrated in a case of retrobulbar neuritis, I feel that drainage should be carried out at once.

Cardiospasm: Report of a Case. Presented by Dr. G. E. Hodge.

D. McK., a youth aged 17, first came to the Western Division of the Montreal General Hospital on Dec. 8, 1938, complaining of pain in the upper portion of his back and in the front of his chest for eight months. The pain was never severe but was dull and aching. During the past three months vomiting occurred after each meal. There had been a loss of weight of some 20 pounds (9 Kg.) in the past month. His history was of interest in that he had never been robust. Whooping cough and measles occurred in infancy, and between infancy and the age of 8 years he had pneumonia four times. Examination showed that the patient was poorly nourished but otherwise normal. A roentgenogram of the chest showed

moderate bronchial and peribronchial thickening. There was no evidence of tuberculosis. The Wassermann reaction of the blood was negative. A fluoroscopic examination was made on December 9 after a meal of barium sulfate. The esophagus was found to be dilated throughout its entire length. At the level of the diaphragm almost complete obstruction was noted; only a small amount of barium trickled through. There was no evidence of new growth or diverticula, and the findings suggested cardiospasm. The patient was admitted to the hospital. On December 15 esophagoscopy was done, with the patient under general anesthesia. The esophagus was found to be dilated throughout and filled with fluid and remnants of food, which were suctioned out. The mucous membrane of the esophagus, particularly in its lower portion, appeared gray and slightly edematous, there being a slight degree of esophagitis present. There was some resistance to the tube at the diaphragm, but this was easily overcome, and the esophagoscope passed into the stomach. There was no evidence of new growth or fibrous bands. The examination suggested a cardiospasm. The patient was greatly improved after the examination. He was treated by weekly dilations of the esophagus with a Plummer's dilator. His vomiting ceased, and his weight, which had been 75 pounds (34 Kg.) on admission, quickly went up to 98 pounds (44.5 Kg.), the weight when he was discharged. A Mosher esophageal dilator was used several times under fluoroscopic guidance, and the esophagus dilated. He has reported at intervals since that time and has now no trouble in swallowing.

The points of interest in this case are: (1) the age of the patient, (2) the marked loss of weight and (3) the immediate improvement with esophageal dilation.

DISCUSSION

DR. MAURICE BONNIER: Much has been said regarding this interesting problem, especially by Imperatori, Plummer, Mosher, Guizez, Jackson and Hurst. Although considerable progress has been made in dealing with it, there remains a fertile field for investigative effort. The various synonyms suggested for cardiospasm, namely, achalasia, phrenospasm, preventriculosis, ingluveosis, hiatal esophagismus and stenosis of the lower end of the esophagus, give an idea of the unknown etiology and the complexity of that particular disease. According to Chevalier Jackson, "Anatomic, pathologic, fluoroscopic, oesophagoscopic and clinical studies have shown that the disease in a large proportion of patients is not spasmodic." It would be too long and out of order here to discuss the different mechanisms that could be held responsible. A lesion in practically any system of the body can be implicated as a possible agent of the disease, such as neurosis, an endocrine imbalance, a change in the liver or in the gallbladder or some pathologic condition of the esophagogastric region. Fortunately, the combination of clinical data and roentgenographic and esophagoscopic findings permits a positive diagnosis, especially when there is an organic stenosis or a definite segmental or diffuse spasm of the lower end of the esophagus. A neuromuscular incoordination of a not yet determined origin seems to the majority of endoscopists the best explanation. It is a fact that in the condition called cardiospasm the patient is obliged to take a certain amount of liquid or food before some trickles down into the stomach. That has been controlled by fluoroscopy. Usually when it has reached the level of the aorta, the column of barium opens to a certain extent the completely closed pinchcock of the lower end of the esophagus.

With Hurst and Jackson, I have a tendency to believe that primarily a nerve fault, involving the sympathetic or the parasympathetic nerves or both, may occur, so that the esophagus cannot properly relax. This inability to relax is regarded as being due to a failure in the coordinating mechanism by which the cardiac sphincter or level relaxes as the gullet muscles contract. Pathologic conditions of the lower lobe of the left lung have been considered by Mosher as factors in producing this abnormality. Between infancy and the age of 8 years the patient, as reported by Dr. Hodge, had pneumonia four times. But from the age of 8 years to 16 or 17 he did not have trouble in swallowing. I can hardly believe there could have been any relation between one of the pulmonary conditions diagnosed as pneumonia and the far distant appearance of the cardiospasm.

In 1927, in discussing a paper on cardiospasm (Mosher, H. P.: Findings with Barium Bougie in Cardiospasm, *Ann. Otol., Rhin. & Laryng.* **36**:1124 [Dec.] 1927), Jackson said emphatically, "There is one thing we do know, that is when you get down to the level of the diaphragm with an oesophagoscope in the normal patient, without anesthesia, you meet with an obstruction that seems to be impassable. [It seemed to be the same with Dr. Hodge's patient, even under general anesthesia.] The door is closed. If you wait patiently, that door will open. When you go down in a patient with cardiospasm you find it closed, but no matter how long you wait it will not open unless you make pressure in the proper place. Then you go through with an oesophagoscope as thick as your thumb."

It seems that ordinarily the cardia is not able to resist the pressure of even a small column of liquid coming from above. That explains the irregularity of the sense of discomfort or fulness behind the lower part of the sternum. For that reason, in so-called cardiospasm the patient does not complain of a real pain, aching or radiating, except when there is secondary esophagitis or ulceration. For the same reason, there is no loss of weight until late, when regurgitations are sufficiently marked to starve the patients.

Again, to quote from Jackson, "The typical oesophageal picture is a widely dilated oesophagus with a grayish, white, pasty mucosa looking like a furred tongue; the coating cannot be wiped away." In the boy presented, I believe the dull aching pain in the chest was due to the degree of esophagitis noted by Dr. Hodge during esophagoscopy. The secondary inflammation and edema increased the regurgitations and impeded the absorption of food to the point that he lost 20 pounds (9 Kg.) in one month. The roentgenographic observations combined with the esophagoscopic findings gave in that case a positive diagnosis of cardiospasm. Moreover, that was confirmed by the rapid improvement following the examination. Undoubtedly it is wise to have definite landmarks about the level of the point of closure before starting any sort of dilation, especially if pneumostatic pressure is to be used. Fluoroscopic guidance is an important help in the treatment of cardiospasm.

If children suffering from esophageal disturbances were systematically examined roentgenologically, I believe that the disease called cardiospasm would be found more frequently. Lately I have treated 2 patients, with good results. The first was a boy aged 6½ years who had been suffering from cardiospasm for seven months. There was the possibility of his having swallowed a small smooth tin whistle just before the symptoms started. All the findings were typical of cardiospasm except for the presence of aspiration bronchopneumonia, which could have made one suspect pulmonary tuberculosis. The patient received twelve dilations in one year. He is now perfectly well and has gained a surprising amount of weight. The other case was that of a girl aged 19, whose symptoms were also typical of cardiospasm. The symptoms started at the age of 10 years. Despite the marked dilatation and obstruction of the esophagus to the barium meal, her weight has been the same for nine years. She was immediately relieved after the first esophagoscopy. Two dilations with a Hurst bougie have been sufficient to bring an apparent cure to date.

Dr. Hodge has outlined many points of interest, and, most of all, with the aid of roentgenology and esophagoscopy, has made an accurate diagnosis and has obtained a remarkable result.

Dr. Gavin Miller: The previous speaker has discussed the diagnosis and medical treatment of this condition completely. I wish to confine my remarks to the cases in which dilation by esophageal bougies or by water, mercury or air pressure is unsatisfactory. Dr. Hodge found in this case definite esophagitis in the terminal portion of the esophagus. In long-standing states this leads to an increasing production of fibrous connective tissue, with final contracture and scarring. Thus this probably purely functional condition finally becomes complicated with cicatricial contracture.

The early surgical approach consisted of opening the stomach and manually dilating the lower end of the esophagus with the fingers. This is successful and

has a low mortality rate, but the esophagus must be emptied first to prevent soiling of the operative field. Another operation in which the dilated esophagus is anastomosed to the stomach may be successful but cannot be achieved without a high mortality rate.

The late Dr. Scrimger advised freeing the esophagus by means of incising the diaphragm. I am informed that this operation was not uniformly successful. Knight divided cardiospasm, or achalasia, of the cardia into three distinct entities: (1) failure of the vagus nerve to function, (2) spasmodic contraction or cardiospasm and (3) hypertrophic stenosis of the cardia. Rake demonstrated chronic inflammatory changes in Auerbach's plexus in some cases of failure of vagal function. Sympathectomy, therefore, by removing the tendency to contract, would offset the failure of the cardia to relax due to vagal incompetence. In a case at the Mayo Clinic a bilateral cervical sympathectomy gave symptomatic relief, though Horner's syndrome occurred. Knight stated that the left gastric artery together with the surrounding fat and nerve tissue should be incised. He reported 3 cases. In the first, of the spasmodic type, the condition was completely relieved; in the second, apparently a case of true achalasia, sphincter tone was diminished but some dilatation persisted, and in the third case, one of hypertrophic stenosis of the cardia, the obstruction persisted. He noted that in a case of the third type the obstruction persisted after death and so could not be expected to be completely relieved by neurectomy.

This operation of excising the left gastric artery and adjacent nerve tissue should be accompanied by a low mortality rate, if any at all. The esophagus should be emptied before operation to avoid the danger of aspiration pneumonia. Operative procedures should be considered only when the usual methods of dilation have failed.

DR. D. H. BALLON: I treated a patient, a teacher aged 42, who was extremely neurotic and a great smoker. She had symptoms suggestive of cardiospasm. She had pain on swallowing and regurgitation of food five or six hours after eating. She had lost 25 pounds (11.5 Kg.) in five years. A roentgenogram after a barium meal showed that the esophagus was dilated. Direct esophagoscopy showed dilatation of the esophagus, with retention of barium and food from previous days. She improved under bougienage.

DR. G. E. HODGE: Cardiospasm is seldom found in persons under 20 years of age, although I have at present under treatment for this condition a boy aged 10 years. It has been rare in my experience to treat a patient so young.

After careful consideration of local and general anesthesia for primary examination in these cases, I prefer a general anesthesia. I have found frequently that passage of the esophagoscope alone is sufficient to give some of these patients considerable relief from their symptoms.

Hurst and Plummer bougies for dilation are used mostly in the clinic at the hospital. The Mosher esophageal dilator is required less often.

There have been a few patients in the hospital who required surgical treatment for this condition. Medical and dietary care of these patients should also be stressed.

Correlation of Clinical, Roentgenographic and Operative Observations in Sinusitis. Presented by Dr. G. E. M. HILTON and DR. E. M. CRAWFORD.

Frequently one finds in treating sinus disease that the clinical, roentgenographic and operative observations do not agree. In an attempt to find out why this happens it was decided to study the observations in a series of cases of sinus disease. During the past two years we have chosen 81 cases, picking them at random from the outpatient clinic. On analyzing the results many interesting observations were made that in the ordinary course of events would be overlooked. The close cooperation of the departments of roentgenology and otolaryngology in the examination of these patients has been of great benefit to the two departments, as it has revealed special and mutual difficulties.

Roentgenographic examination of the paranasal sinuses requires considerable care. Satisfactory shadows of the soft tissue are necessary, and one or more repetitions of the examination may be necessary to secure the necessary detail. Four roentgenograms are necessary, i. e., one of the frontal and ethmoid sinuses, one of the maxillary sinuses, a true lateral roentgenogram and one taken with the head in the upright position. The last is of special value when fluid is in the sinus. The individual differences in the thickness of the bones of the skull must also be taken into consideration, as well as the patient's ability to remain still during the examination.

At the clinical examination the following interesting features were observed: (1) the preponderance of staphylococci in cultures of material from the nose, (2) the hereditary tendency to allergy, (3) the allergic history in about 25 per cent of the cases studied, (4) our failure to demonstrate eosinophils in the nasal secretions of many of the clinically allergic patients, (5) the presence of eosinophils in the nasal secretions of patients clinically nonallergic and (6) the results of cultures taken from the antrums at the time of operation.

We have found in some cases in which the roentgenographic observations do not agree with the operative findings that the operation was performed a considerable time after the roentgenograms were taken. Roentgenograms should be taken as short a time as possible before operation.

Old sinus infections which have cleared may leave their mark on the sinus so that it will be recorded on the roentgenogram, although clinically there is no evidence.

Asymmetry of the sinuses and varying densities of bones are often confusing, particularly in transillumination.

A special record card was evolved. The clinical, operative and pathologic observations were recorded on one side and the roentgenographic observations on the other. Four degrees of change were recorded and entered as minimal, moderate, marked and maximal. In this comparison it was determined that any moderate, marked or maximal pathologic changes should show agreement with the roentgen ray changes but that the degrees need not correspond and that minimal changes need not exclude agreement, provided the more marked changes were in agreement. In recording the roentgenographic changes, the following terms were used: (1) fluid, (2) thickened membrane, (3) polypoid degeneration of the mucous membrane and (4) changes in the bone. The patients who did not show agreement had as a rule roentgenograms which were overexposed or were taken with the use of the Bucky diaphragm or with films which were not intended for photographing the sinuses.

This study demonstrated several things, among which the following were the more important: 1. The roentgenographic examination must be precise. 2. Roentgenograms of the best possible technical detail are necessary. 3. One must be prepared to reexamine the sinuses in view of the individual differences in the thickness of the bones of the skull. 4. Before an operative procedure is undertaken a reexamination of the sinuses is necessary if there is an interval of a few weeks between the original examination and the operation. 5. In most cases, if not in all, iodized poppyseed oil is not necessary to determine the degree of thickening in the mucous membrane of the sinuses. 6. The roentgenographic examination has a distinct place in recording the progress of treatment, but it is necessary to have roentgenograms that can be compared; that is, they need to be of the same technical quality.

These observations are not new. They are in many respects a repetition of what individual roentgenologists have found. What we do wish to point out is the value of correlation of clinical and roentgen ray observations.

DISCUSSION

DR. A. E. CHILDE: It seems to me that there are several reasons why roentgen examination of the sinuses has fallen into disrepute. Perhaps one of the main reasons is the roentgenologic department itself. It is not always easy

to get good roentgenograms. If these are not obtained at the first visit, the patient should return. Then, too, a patient is often sent to the roentgenologist for one roentgenogram of the sinus, from which all information is supposed to be obtained, when four roentgenograms is the minimum for complete examination.

Again, I should like to stress the discrepancy due to the time interval. Dr. McNally and I have recently seen 2 patients for whom we happened to have roentgenograms made at daily intervals for several days. We were amazed to see the changes which took place in only twenty-four hours. I should like to ask a question concerning the asymmetry of the antrums. Do the investigators think that it is perhaps due to infection early in life, or is it a phenomenon unconnected with infection?

Dr. Hector Mortimer: With regard to the question on antral asymmetry, it is interesting to note that recently Levene and his associates published a study on some 4,000 cases of sinusitis (Levene, G.; Johnson, L. F.; Lowman, R. M., and Wissing, E. G.: Rôle of Hypophysis in Cranial Osteomyelitis, Petrositis and Sinus Infection, *Endocrinology* **22**:521-527 [May] 1938). They found that sinusitis most frequently occurred in the types of craniums characterized by large sinuses. Antral growth is in close relation to the eruption of the second dentition, and infection occurring then, if exercising any influence, would most likely be in the direction of handicapping antral development, a fact which Levene's findings would seem to contradict.

More recently, with Dr. Crawford and Dr. Hilton, I had the opportunity of studying the roentgenograms of 150 patients with sinusitis in the Montreal General Hospital. All cranial types were found, and no correlation could be made between the size of the sinus and the infection. We did, however, note the frequency of septum deviation, which is frequently associated with antral asymmetry. This condition is a recognizedly common one, and since we had no adequate sample of the population of Montreal for purpose of comparison, we were unable to say whether the frequency of this deformity in cases of sinusitis was significant.

In his study of criminals, Hooten found septum deviation more frequent in criminal than in noncriminal groups, and he interpreted such asymmetry in growth of the face as part of the evidence of a general biologic inferiority. It is possible that such inferiority might play a part in the etiology of sinusitis.

CHICAGO LARYNGOLOGICAL AND OTOLOGICAL SOCIETY

George T. Jordan, M.D., *President*

Walter H. Theobald, M.D., *Secretary*

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Pituitary Dwarfism with Atrophic Rhinitis. Dr. Noah Fabricant and Dr. Pat Bronstein.

Children exhibiting sexual infantilism and defective growth (Lorain-Lévi dwarfs) may be normal at birth and develop adequately until some time in childhood, when growth either ceases or becomes retarded. No special organs are involved. The proportions are those of a normal child. The genital retardation is probably not in excess of the retardation of physical development, and the secondary sexual characteristics are markedly delayed or absent. The mentality may be normal, although the behavior is often immature.

No gross evidence of dystrophy of the bones or joints exists, although chondro-epiphysial changes, poorly outlined osseous centers with decreased bone density,

* This program was presented by the Department of Otolaryngology, University of Illinois.

have been described. The ossification centers usually appear at the normal time, whereas delay in epiphysial closure is a consistently positive finding. The basal metabolic rate may be normal, but some question exists whether there is a coexistent mild hypothyroidism which may induce slight delay in carpal development and moderate reduction of the basal metabolic rate.

The case of a pituitary dwarf aged 15 with sexual infantilism (Lorain-Lévi type), who exhibited two unusual abnormalities, a calcified lesion in the sella turcica and atrophic rhinitis, is described. Rarefaction of the tibia is noted.

Estrogens, which have been employed by others in the treatment of atrophic rhinitis, were not used for this patient because of the possibility of premature epiphysial closure.

The irregular administration of anterior pituitary extracts containing growth-promoting substances over approximately two and a half years presumably produced a gain in weight and an increase in height, but apparently had no effect on the atrophic rhinitis.

DISCUSSION

DR. I. PAT BRONSTEIN: It is unusual to be able to show a Lorain-Lévi dwarf for whom the diagnosis is more than presumptive. This patient presented a calcified mass in the sella turcica and, in addition, atrophic rhinitis. The case is important since it raises the question of the use of various endocrine products. I have had occasion to go over the literature in cursory fashion and have noted the increasing number of articles on the endocrinologic aspects of ear, nose and throat diseases. I should like to stress some basic facts. This child is a dwarf with two abnormal conditions, undersize and sexual underdevelopment. A number of authors have advised the use of estrogenic material for atrophic rhinitis, but if one uses it inadvisedly for this type of child it may defeat the more important purpose of increasing growth. The possibility of premature closure of the epiphyses by the excessive use of preparations of sex hormones is of sufficient importance to warrant caution.

I have encountered in the last two months 2 preadolescent children in whom an excess of sex hormones was found. One, a child aged about 11, who was pseudohermaphroditic, had an excess of androgen in the urine and practically complete epiphysial closure. Nature can thus produce what is accomplished artificially by giving excess amounts of these products.

Slides illustrating two other conditions of otolaryngologic significance are shown: 1. A child with a huge tongue, referred as a cretin because of the macroglossia, is demonstrated. Biopsy revealed true muscular hypertrophy. 2. Two cretins are shown because of deafness. One was untreated until 10 years of age, and possibly the deafness represented an end stage of cretinous degeneration. The other is a child treated actively and adequately since the age of 6 months. In this case the cause of the deficient hearing is not so clear.

Carcinoma of the Esophagus in Association with That of the Tongue. DR. J. SCHOOLMAN.

The first patient shown had had a resection of the right half of the tongue because of a malignant growth twenty-two years ago. The patient recently came into the clinic complaining of difficulty in swallowing. Examination of the floor of the mouth showed marked scarring but no recurrence of the lingual lesion. Esophagoscopic examination revealed an obstructive tumor mass involving the upper third of the esophagus halfway between the cricoid and the aortic notch. On biopsy this proved to be an anaplastic squamous cell carcinoma. Gastrostomy was advised, but the patient left the hospital without permitting this procedure.

The second patient was sent into the hospital for tracheotomy because of acute respiratory distress. Examination revealed a tumor mass at the base of the tongue and an infiltrating mass obstructing the trachea above the bifurcation. Questioning brought out the fact that the lingual tumor had been treated. Autopsy revealed a hornifying squamous cell carcinoma of the tongue containing a radon seed. The

second tumor was an ulcerated squamous cell carcinoma of the esophagus which perforated into the trachea and metastasized to a perigastric lymph gland.

Two questions are discussed: 1. Is the tumor of the esophagus secondary to that of the tongue, and if it is secondary, was the process one of metastasis or one of implantation? 2. Are both the tumors primary?

In both cases cited the lungs were free. An extension from the tongue to the esophagus must pass through the deep cervical glands and continue against the lymph current draining the esophagus. In the second case both lesions were present at the same time. The time factor in the first case also serves to discount the question of metastasis, the period between tumors being more than double that which Holden reported to have elapsed between the removal of a carcinoma of the breast and the appearance of osseous metastases.

Until it is definitely settled whether implantation can occur in the esophagus, it may be assumed that the lesions in these cases are probably multiple primary tumors and it may be concluded (1) that multiple primary tumors do occur in a related organ system and (2) that the cure of one lesion should keep the physician alert for the possible appearance of another even after a prolonged interval.

Neoplasms of the External Auditory Canal. Presented by DR. M. F. SNITMAN.

The patients whose cases are demonstrated were seen rather late in the course of the disease, and as a result it is difficult to determine definitely whether the growths originated in the middle ear or in the external canal. However, from a study of the history and the histologic changes it would appear that the majority originated in the external auditory canal.

From 1925 until the middle of 1939, 8 patients with carcinoma of the external and middle ear were observed. During the latter months of 1939, 5 patients with carcinoma of the external auditory canal were seen. On two occasions, 4 of the 5 were hospital patients at the same time. All the patients were women, the youngest 25 and the oldest 51 years of age. In 4 the lesion was in the right ear, while in 1 the left ear was involved; all the lesions were primary.

The histologic observations of each case are presented.

I wish to emphasize that these conditions can be recognized early if due attention is given to any growth or polyp in the canal or middle ear. Early biopsy should be the rule in such circumstances, as in others. It is distinctly advantageous for the clinician to have an understanding of pathology, since it enables him to coordinate clinical knowledge with the biopsy observations. For the pathologist this coordination is usually not feasible.

Fatal Hemorrhage After Puncture of the Maxillary Sinus. DR. JOHN WALL.

A man aged 54 stated that about three weeks prior to examination he noticed a soreness over the right side of the nose; there were no symptoms. The following day severe pains developed over this area and spread to the right side of the forehead, to the right eyeball and over the right parietal region. He had a feeling of weakness accompanied by generalized muscular pain, more pronounced in the back. Several days later, the right eye became puffy and he began to see double on looking forward and to the left.

When the patient was first seen the right eye showed an external paralysis of the third nerve, with moderate exophthalmos; the pupils reacted to light and in accommodation, and the conjunctiva was sensitive. The nose was apparently normal, except for a moderate deviation of the septum. The epipharynx contained only a small amount of mucoid discharge. Transillumination of the sinuses revealed clouding of the right frontal and maxillary sinuses. Roentgen examination corroborated the transillumination.

A puncture of the right antrum was made under the inferior turbinate, and a small amount of pus with much bleeding was obtained through irrigation. During the making of the puncture a soft lateral nasal wall was felt, which gave the

impression of a soft tumor-like mass within the antrum. The extreme pallor of the patient and the pains in the back, in addition to these findings, pointed to a carcinoma with multiple metastases in the skeleton, or to a myeloma. That afternoon severe epistaxis occurred, but this was easily stopped with nasal packings.

The patient continued to show signs of internal bleeding; the pulse became thready and rapid, and the blood pressure dropped. He then began to vomit large amounts of fresh blood. Repeated examination of the nose failed to show any bleeding, and a hemorrhage originating in the stomach was considered. The symptoms continued, and in spite of two blood transfusions and the injection of fluids intravenously the patient gradually became weaker and comatose and died the following morning, about twenty-four hours after the puncture of the sinus.

Autopsy showed a large carcinoma of the stomach and generalized carcinomatosis of the dura. These multiple meningeal metastases were particularly present in the region of the superior orbital fissure and were the cause of a large depression in the temporal lobe of the brain. There was no gross tumor tissue in any of the sinuses.

Additional sections made of the original gastric tumor and of the meningeal metastases showed them to be identical with the tumor tissue found in the sinuses. Active mitosis could be seen in some of the cells.

An effort was made to correlate the severe gastric hemorrhage and rapid death with the puncture of the antrum. It is stated in the literature that death following antrum puncture may result from an air embolus, cocaine poisoning or a reflex irritation of the vagus nerve, which may be stimulated by branches of the first or the second division of the trigeminal nerve. It has been proved that there is a definite connection with the fifth nerve and the vagus nerve and that the latter can be stimulated or irritated at will with irritants in the nasal or antral mucosa. It is assumed that since the blood vessels of the stomach already had been damaged by the involvement with carcinomatosis the vagal irritation, by causing disturbance in the circulation, started the active hemorrhage. The vagus nerve in turn was stimulated by the nasal reflex through the branches of the fifth nerve in the antrum mucosa. This was a direct result, however, of the antrum puncture and irrigation.

DISCUSSION ON PAPERS BY DRS. SCHOOLMAN, SNITMAN AND WALL

DR. HANS BRUNNER: The 2 cases discussed by Dr. Schoolman lead to the difficult and important question as to whether it is a matter of two primary tumors or of one tumor and implantation metastasis in the esophagus. In his logical comment, Dr. Schoolman decided in favor of the possibility of multiple primary carcinomas. Nevertheless, I should like to emphasize one point which can be used in behalf of the diagnosis of implantation tumors in the esophagus. Many decades ago it was found that the mucous membrane of the esophagus contains glands of a gastric type, namely, glands which probably produce pepsin. These glands are found only in the cardiac portion of the esophagus and in the uppermost part, between the levels of the cricoid cartilage and about the fifth tracheal ring. It is obvious, then, that in these areas implantation carcinomas can but rarely develop, because of the digestive power of the gastric juices. But there is no inhibition to the development of primary carcinomas in these areas. It is noteworthy that in both cases reported by Dr. Schoolman the tumors within the esophagus avoided these areas, a point which is suggestive for the diagnosis of implantation tumors.

The case reported by Dr. Wall is of great importance because it acquaints us with a disease of the mucous membrane of the nose which has been suspected but heretofore not proved. In this disease a great part of the capillaries and the lymph vessels of the mucous membrane is found to be filled with emboli of carcinoma cells. This condition is well known as occurring in the pleura and lungs and in the dura but not as appearing in the nasal mucous membrane. According to these findings the disease described by Dr. Wall must be called "carcinomatosis of the nasal mucous membrane." Clinically, a diagnosis of that disease cannot yet be made. However, since it may be assumed that this disease is not extremely

rare, the next duty is to discover the clinical symptoms of carcinomatosis of the nasal mucous membrane and establish thereby a clinical as well as a pathologic entity.

DR. JOSEPH C. BECK: I was astonished to hear Dr. Snitman say that in histologic examinations the pathologist's point of view should not be taken into account. I think that is an erroneous assumption. Granted that the pathologist does not know the clinical picture and that, as has been my plea for many years, clinicians should study pathology, still the pathologist is needed. I should like Dr. Wall to give the identity of that cell which he demonstrated as a carcinoma cell. One variety is anaplastic; another is not. However, the pathologist is essential in making the diagnosis with the clinician.

To me the presentation of these 3 cases and of all the work that has been done has been a treat; to see the ease with which the pathologic diagnoses were made by these young men is wonderful. Progress is being made by leaps and bounds, and soon there will be no failures by the board (maybe)—certainly not in pathology. I want to compliment the department on this excellent presentation.

DR. J. SCHOOLMAN: I want to thank Dr. Brunner for his discussion and for allowing me to take advantage of his comments in the department, as well as for the opportunity I have had of putting thought on this subject outside the department. In referring particularly to this gastric type of gland which may lodge in the esophagus, I should like to say that it will be remembered that the detached tumor cell has to pass an area of gastric digestion and will be less likely to implant disease into even the weakened area of resistance in the esophagus below it.

DR. M. F. SNITMAN: I agree heartily with what Dr. Beck has said, but I did not mean to imply that the clinician should not work in conjunction with the general pathologist. However, it is to the advantage of the clinician to interest himself in the study of the diseased tissue, because he is thus able to coordinate the clinical picture with the histologic changes. This has been well borne out in the experience of Dr. Brunner and myself.

DR. J. WALL: This tumor was recognized and diagnosed as carcinoma simply on the basis of the highly differentiated cells, and as long as there was no outstanding feature, it was diagnosed as other carcinoma cells would have been. This condition may be unrecognized, as would have been true in this case had not Dr. Brunner asked that further investigation be made; it was accepted as involving the meninges alone, and only on Dr. Brunner's insistence was it further studied.

Intravenous Feeding with Special Reference to Amino Acids. DR. ALBERT H. ANDREWS JR.

The usual intravenous administration of water, salt and carbohydrate is inadequate for prolonged therapy because of the absence of protein. Intravenous administration of a 5 per cent solution of the essential amino acids (the preparation used was supplied by the Baxter Laboratories, Inc., Glenview, Ill.) is a proposed method of maintaining an adequate protein intake. Transient reactions consisting of fever and chills occur if the administration is too fast, but no harmful effects have been observed after the reactions subsided.

Sufficient data on the clinical use of solutions of essential amino acids have not as yet accumulated, but the evidence so far indicates that this method does supply protein in a utilizable form. Clinical use of such solutions is indicated at present for those patients for whom prolonged intravenous feeding is essential for the maintenance of life.

DISCUSSION

DR. PAUL HOLINGER: The problem of feeding a patient in whom there is dehydration because of esophageal obstruction has been a desperate one as long as there has been esophageal obstruction. This recent advance that Dr. Andrews

has presented has been a major one in therapy. The first step usually taken is gastrostomy. However, the rate of mortality from gastrostomy among patients with dehydration and cachexia is extremely high; it is only by other means than immediate gastrostomy that the percentage of deaths can be lowered. Patients generally have a deficiency of proteins not only because there has been complete obstruction for a few days before hospitalization but also because they have not been able to take adequate quantities of proteins for weeks or months previously. The benefit from increasing the fluid and carbohydrate intake alone has certainly been augmented by the addition of intravenous amino acids. The improvement and sense of well-being which the patient displays are gratifying and much more pronounced than the well recognized reaction to salt and dextrose alone.

Osteomyelitis of the Frontal Bone in the Absence of Frontal Sinusitis.
DR. ROBERT B. LEWY.

This article will appear in full in a later issue of the ARCHIVES.

DISCUSSION

DR. SHERMAN SHAPIRO: These interesting case reports speak for themselves. They illustrate as no didactic discussion can the important role of the diploetic layers of the cranial bones in the production of osteomyelitis. I should like to say a few words as to classification: One gets the impression that a good many men consider only a spreading osteomyelitis as a true osteomyelitis of the cranial vault. I prefer the classification given by Dr. Lewy, not only because it is in accord with clinical experience but also because it is in line with the histology of this condition. Particularly in recent communications it has been shown that along with the destructive and necrotic processes that take place in osteomyelitis of the cranial bones there is a reparative process resulting in granulation tissue and bone and that sometimes this process proceeds to actual osteosclerosis. One gets the impression that the prognosis depends largely on this reparative process.

I recall a particularly interesting illustration of this fact. Two or three years ago a nurse was sent into Research Hospital from downstate, with a history of chronic infection of the occipital bone for three or four years, arising from an infection of the mastoid. She had a mastoid fistula dating from a previous operation as well as an occipital fistula near the midline. It was decided to connect the two fistulas by removing the occipital bone between them. At operation not only was the occipital bone found to be markedly thickened—¾ to 1 inch (1.9 to 2.5 cm.)—but the diploe was obliterated, this being an extreme example of the reparative process. This woman, by the way, made a complete recovery.

A practical point to be drawn from this classification is that in those cases in which the clinical and roentgen findings indicate a localizing process there is no need for the extensive procedures that are done in cases of spreading osteomyelitis and the patient will probably get well if treated with more conservative measures.

The causative organisms in the case just cited were Streptococcus haemolyticus and Staphylococcus aureus. In another case of cranial osteomyelitis following a simple mastoidectomy, a case in which the disease ended fatally, Streptococcus mucosus was responsible.

DR. T. C. GALLOWAY: One factor that is often overlooked is the nature of the infective organisms in the production of osteomyelitis. Mosher, Furstenburg and others have definitely worked out in studies of diploic bone the role of the staphylococcus, which produces extension by invading the veins. The disease can extend through apparently sound bone to break out under the periosteum or over the dura at some distance. The only safe treatment is radical removal.

The processes that begin around the antrum seem different. I have seen 4 such conditions this year, 3 of which were fatal. Why should a process which begins in relation to the cancellous bone of the antrum be so hard to arrest? There are no easily infected vascular channels. In 3 of the cases cited the anomaly was due to infection with an anaerobic, slightly hemolyzing streptococcus and was

associated with much soft tissue swelling and adenopathy, which might suggest a cellulitis with lymphangitis. It is hard to get good cultures of anaerobic organisms, and routine cultures, unless made in the depth of brain broth, will not pick them up. In my last case the condition developed after the formation of a simple antrum window. It looked as if it would be fulminating, and it advanced rapidly as long as I waited. It was, however, quickly arrested by the technic advised by Meleney for anaerobic streptococci. An oblique incision of about 2 cm. was made down and out from the lacrimal fossa; the periosteum was freed under the whole infected area; a 0.5 cm. button was removed (the laboratory report was of osteitis), and the soft tissues were freed intranasally over the inferior turbinate. Twice daily for one week a freshly prepared 30 per cent paste of zinc peroxide in water was injected into the undermined areas. No further extension occurred, and healing was relatively rapid. Sulfapyridine had been given, but the administration of that drug was stopped on account of a rash before this intervention.

DR. ROBERT LEWY: I appreciate the discussions of Dr. Galloway and Dr. Shapiro. I think the question of bacteriology of osteomyelitis of the frontal bone is subject to considerably more scrutiny than it has had in the past. In the 1 case in which the infection was in the maxillary sinus and finally involved the frontal bone, it is hard to trace the pathway of the infection. In this case a septal abscess developed and from that point osteomyelitis of the frontal bone. Perhaps the ethmoid sinus was involved. No particular involvement was found, but if there was any it might support the theory that the frontal sinus is nothing more than an enlarged ethmoid cell, and therefore the course of this infection would seem much more logical than it now appears.

Retropharyngeal Fibroma and Tertiary Syphilis: Report of a Case. DR. L. Z. FISHMAN.

A 35 year old white man was first seen in December 1936, with the complaints of cough, difficulty in swallowing and breathing, swelling of the neck and a loss of 13 pounds (5.9 Kg.) in weight in seven months. A tentative diagnosis of carcinoma of the esophagus was made at the time of admission.

Because of reports of positive serologic findings, antisyphilitic therapy was instituted and continued for more than two years. In February 1939 a mass weighing 345 Gm. was removed from the retropharyngeal space.

Indirect laryngoscopic examination on the tenth postoperative day revealed that both cords were fixed, the left being markedly abducted and the right in the "medio" paramedian position. The right vocal cord evidenced slight motility at the time of the patient's discharge from the hospital, on the twenty-seventh postoperative day, and the left remained in the "medio" paramedian position.

One year before the removal of the tumor a correct diagnosis had been made by means of an exploratory operation on the neck for the purpose of obtaining a specimen for biopsy. Despite this, surgical treatment was delayed because of the coincidental tertiary syphilis.

Although there was considerable prolonged pressure against the posterior surface of the larynx and trachea, to the extent that the latter was compressed to a narrow slit, there was no resulting chondromalacia. It was not difficult to enter the narrow lumen of the trachea and to pass a cannula beyond the seemingly impassable obstruction. The lumen of the trachea was completely restored after the extirpation of the tumor.

Microscopic studies made of a number of sections of material from different parts of the mass and carried out by selective methods of staining proved the tumor to be a benign fibroma durum; one portion is suggestive of a leiomyoma or a fibroma molle. In either event, attempts to correlate the pathogenesis of this fibroma with the patient's syphilitic infection can be only conjectural.

Of interest are the unusual size of a fibroma of the retropharynx and the extensive exposure occasioned by removal from such a hazardous region. The reparative response of the tissues of this patient was not disturbed by his previous syphilitic infection.

Syndrome of Petrous Tip. DR. W. LOEB.

This patient is a white woman, aged 30, whose present illness began in September 1939. She contracted an infection of the respiratory tract accompanied by pain in the right ear. There were elevation of temperature, a nonproductive cough and diffuse headache. Paracentesis of the right ear was performed four days after the onset of the disease, after which the temperature returned to normal, where it remained during the ensuing course of the illness. A second paracentesis was performed three days later. There was moderate purulent drainage from the right ear, but the pains persisted.

Three weeks after the onset the ear was still draining; there was right-sided frontoparietal headache, together with some pain deep in the right eye. The patient then noticed double vision on looking to the right. The pain in the right eye increased, and the diplopia persisted. In the sixth week of the illness she complained of gradually increasing rotational dizziness, occurring intermittently.

Examination showed a draining central perforation of the right drum, paralysis of the sixth nerve on the right and second degree nystagmus to the left. There was no sagging of the canal wall, tenderness over the mastoid or edema about the tip. With the right ear the whispered voice was heard at a distance of 12 feet (3.6 meters); in the Weber test the sound was lateralized to the right; the reaction to the fistula test on the right ear was normal. The left ear was normal. General physical examination revealed no abnormality. The Wassermann reaction of the blood was 4 plus, the patient having had two years' continuous antisyphilitic therapy. Spinal tap revealed clear fluid under normal pressure, containing 3 white cells and no increase in protein. Results of serologic studies were normal.

Roentgenograms showed a clouding of the mastoid process, and the petrous tip could not be made out on the right side. A diagnosis of subacute mastoiditis and petrositis was made. An atticoantrotomy was done, revealing granulations in the antrum, over the horizontal semicircular canal and eroding the tegmen. The dura was exposed and was seen to be covered with granulations. The lateral sinus was also exposed and appeared normal.

One month after operation the patient felt well and had gained weight. The paralysis of the abducens nerve was slowly diminishing. There was continued discharge from the right ear but no pain. Spinal tap was again done, to check the serologic studies. At this time there were 30 leukocytes and increased protein, and results of serologic studies were normal. Shortly afterward the patient complained of occasional severe pain deep in the right eye. The question then arose as to whether the continued paralysis of the abducens nerve and headaches were due predominantly to syphilitic meningitis or to petrositis. Further roentgenograms revealed a continued rarefaction of the petrous tip on the right side.

Nine weeks after the first operation the patient was readmitted to the hospital. Examination showed diplopia on looking to the right only and no nystagmus. The whispered voice was heard at 20 feet (6 meters) in the affected ear. The reaction to the Weber test was lateralization to the affected side. Results of neurologic examination were normal. Examination of the spinal fluid showed 3 cells and no increase in protein, and the serologic studies revealed no abnormality.

The petrous apex was approached by the epidural route, the roof of the attic and eustachian tube being removed and the dura reflected away. No pus was found, but there was soft bone, suggestive of a healing osteomyelitis. This was corroborated by the microscopic sections. The incus, lying loosely in granulation tissue, was removed. One hour postoperatively the patient was seen to have complete paralysis of the facial nerve on the right. This is slowly subsiding, about a month after operation. The paralysis of the abducens nerve was completely gone by the third postoperative day. The course was otherwise normal.

Six weeks after the second operation, the whispered voice is heard in the right ear at a distance of 2 feet (0.6 meter), and in the Weber test the sound is lateralized to the right. There is no paralysis of the sixth nerve.

The case illustrates how hard it is to determine whether the cranial nerve involvement was due to syphilis or petrositis and is an example of the difficulties encountered in the diagnosis of petrous abscess by roentgen examination.

DISCUSSION

DR. T. J. WACHOWSKI: This case presented two problems, the first relating to the differential diagnosis of the obvious pathologic condition seen in the roentgenograms. In this respect the roentgenologic department was not able to aid much, because either a gumma or an advanced petrositis could produce the destruction seen.

The other problem related to the diagnosis of petrositis per se. This was more difficult because of (1) the position of the petrous bone in the center of the skull, where it is inaccessible for sharp roentgenograms, and (2) the fact that in the adult the petrous area is built much as the mastoid areas are built in the child, that is, consisting of cellular air spaces within a medullary framework. The changes may be due to asymmetry of development, some of which is probably related to infections of the middle ear in childhood. In inflammatory pathologic conditions the changes differ in the acute and in the chronic stage. In the acute stage there is increased density, due to loss of air spaces secondary to empyema of the cells. These early changes are difficult to determine unless one has an earlier "scout" roentgenogram for comparison, and I believe that it is advisable to make such a roentgenogram, preferably with the patient in the Taylor position, in all cases of mastoiditis. As the disease progresses there is loss of calcium in the area, due to a type of osteomyelitis which develops. This gives rise to areas of decreased density. While these areas may occur anywhere, they are more common in the thin apex of the petrous bone, and for that reason the Stenvers position is most suited for showing them. Other views, such as that made with the patient in the Mayer position, to show cells at the posteromedial angle, may be necessary for a full appreciation of the pathologic condition. For a base roentgenogram for future reference, however, I believe the Taylor position is adequate.

DR. HANS BRUNNER: Insofar as prognosis is concerned, there is a great distinction between the different kinds of petrositis. According to my experience the most dangerous of these types are those in which the symptoms of the petrous apex become evident in the late stage of an acute otitis media, i. e., in the fourth to the sixth week. This very thing occurred in the case discussed by Dr. Loeb. Furthermore, since roentgen examination revealed definite destruction of the petrous apex, the operation was considered imperative. The normal appearance of the drum and good hearing at that time indicated the subdural approach and contraindicated the technic of Ramadier. The operation was difficult, as there was no tract leading to the apex. No granulations and no pus could be found. However, the bone was removed from the roof of the middle ear and eustachian tube and from the anterior surface of the pyramid up to the gasserian ganglion. During this procedure the geniculate ganglion was injured, resulting in a postoperative paralysis of the facial nerve. The removed bone did not give the impression of healthy bone, and the microscopic examination of it revealed osteomyelitis and osteitis healing with the production of osteoid bone and connective tissue. Since neither osteoid bone nor connective tissue produces a shadow in a roentgenogram, the roentgen evidence in this case is readily explained. After the removal of the bone, the headache and the paralysis of the abducens nerve disappeared. It is probable, however, that they would have disappeared without operative intervention. Consequently, the conclusion may be drawn that all symptoms related to the petrous apex, including a positive roentgen finding, can be the result of a healing osteomyelitis and osteitis of the petrous apex. In view of the great tendency of all types of petrositis to heal spontaneously, this case again proves that operations on the petrous tip are seldom necessary, an opinion which I have held since 1926, when I became especially interested in such cases.

Book Reviews

Précis d'oto-rhino-laryngologie. By Georges Laurens; Maurice Aubry, laryngologiste des Hôpitaux de Paris, and André Lemariey, laryngologiste des Hôpitaux de Paris. Second edition, revised and corrected. Price, $3.90. Pp. 1242, with 460 illustrations (from the collection of Digest of Medicine). Paris: Masson et Cie, 1940.

The authors present a clearcut cross section of the entire field of oto-rhino-laryngology in a concise manner. Although this volume was written primarily for students, general practitioners and younger otolaryngologists, it is a valuable reference book for specialists.

Detailed anatomic descriptions are omitted, but sufficient anatomy is included to illustrate the practical applications. Stress is laid on pathology, etiology, prognosis, diagnosis and treatment.

The technic of examination of the ear, nose, throat and larynx is dealt with in detail. Special emphasis is placed on hearing tests, vestibular examinations, petrositis, anginas with hematologic variations and interpretations of roentgenograms, particularly with regard to cancer of the larynx.

Treatment is considered from a practical point of view. The operative procedures are clearly and simply outlined. The many illustrations aid graphically in giving a better understanding of the point in question.

This second edition is splendidly arranged. Having avoided many obsolete theories, it is completely up-to-date and should be a valuable addition to one's library.

Directory of Otolaryngologic Societies *

NATIONAL

American Medical Association, Scientific Assembly, Section on Laryngology, Otology and Rhinology

Chairman: Dr. LeRoy A. Schall, 243 Charles St., Boston.
Secretary: Dr. Louis H. Clerf, 1530 Locust St., Philadelphia.
Place: Cleveland. Time: June 2-6, 1941.

American Academy of Ophthalmology and Otolaryngology

President: Dr. Frank Brawley, 30 N. Michigan Ave., Chicago.
President-Elect: Dr. Frank R. Spencer, Physicians' Bldg., Boulder, Colo.
Executive Secretary: Dr. William P. Wherry, 1500 Medical Arts Bldg., Omaha.
Place: Hotel Cleveland, Cleveland. Time: Oct. 6-11, 1940.

American Broncho-Esophagological Association

President: Dr. Gabriel Tucker, 250 S. 18th St., Philadelphia.
Secretary: Dr. Paul Holinger, 1150 N. State St., Chicago.

American Laryngological Association

President: Dr. Gordon Berry, 36 Pleasant St., Worcester, Mass.
Secretary: Dr. Charles J. Imperatori, 108 E. 38th St., New York.
Place: Atlantic City, N. J. Time: May 28-30, 1941.

American Laryngological, Rhinological and Otological Society, Inc.

President: Dr. J. Mackenzie Brown, 1136 W. 6th St., Los Angeles.
President-Elect: Dr. James A. Babbitt, 1912 Spruce St., Philadelphia.
Secretary: Dr. C. Stewart Nash, 708 Medical Arts Bldg., Rochester, N. Y.
Place: Los Angeles. Time: June 1941.

SECTIONS:

Eastern.—Chairman: Dr. N. S. Weinberger, Robert Packer Hosp., Sayre, Pa.
Southern.—Chairman: Dr. William G. Kennon, Doctors Bldg., Nashville, Tenn.
Middle.—Chairman: Dr. Walter H. Theobald, 307 N. Michigan Ave., Chicago.
Western.—Chairman: Dr. Robert C. Martin, 384 Post St., San Francisco.

American Otological Society

President: Dr. George M. Coates, 1721 Pine St., Philadelphia.
Secretary: Dr. Isidore Friesner, 36 E. 73d St., New York.
Place: Atlantic City, N. J. Time: May 26-27, 1941.

* Secretaries of societies are requested to furnish the information necessary to keep this list up to date.